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Contents

Benchmarking for World-Class Manufacturing – Concept, Framework & Applications

S.N. Nandi & D.K. Banwet

World class manufacturing refers to a level of manufacturing excellence that enables a manufacturer to compete with a global player. Benchmarking being a management tool for diagnosis and innovation, helps a manufacturer to reach above mentioned world class level, authors assert in this article. Performance and diagnostic benchmarking with their wide variation of frameworks could be effectively applied to identify areas for improvement. Process benchmarking provides proven practices to a receptive organisation to bridge the gap between its performance with the one being achieved by a world class organisation. Therefore, benchmarking irrespective of any kinds, will contribute greatly to bring about a world class manufacturing capability.

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Manufacturing, a process of adding value to physical inputs, has got resurgence in the west during 80's and onward in the last century, as Japanese manufacturing practices having been perceived to be superior to American ones. A new term, world- class manufacturing was coined in 1986 essentially to refer to the perceived successful Japanese manufacturing techniques. Since then, most of the well known manufacturing establishments in the world have implemented such manufacturing techniques with varying degrees of success. However, a question has been raised whether world-class manufacturing should only refer to simple application of such manufacturing techniques or it should reflect certain level of capability that manufacturers would develop as a result of application of similar kinds of techniques. Latter view appears to be taking more creditability in current times. After all, a world-class manufacturer should have the necessary capability to compete with global players.

Since global competition is rising with more and more national economies becoming liberalized and globalised, it is imperative that a technique like benchmarking that is recognized as a catalyst for improvement and innovation should find a place with manufacturers to reach a level of world-class status. 'Benchmarking is used to improve performance by understanding the methods and practices required to achieve world-class performance levels' (Camp, 1995, p. 15). In fact, it happened with Xerox Corporation, U.S.A. which invented Benchmarking sometimes in the later part of 70's. When Xerox Corporation, a pioneer in Xeroxing, started losing market share to Japanese competitors, it developed the benchmarking tool by which it could quickly learn many effective work practices from different sources in order to achieve a level of world-class performance and regain market leadership. Benchmarking, therefore, has a legitimate role enabling

an organisation to achieve world-class manufacturing capability. Unfortunately, there is hardly any literature which has discussed the role of benchmarking in helping a manufacturer reach world-class status.

Benchmarking is used to improve performance by understanding the methods and practices required to achieve world-class performance levels.

Though India is a country of high potential, its manufacturers have still to improve their manufacturing practices a great deal to become world class manufacturers. Historically, Indian industries were inward looking till the end of 1980's. The opening up of the Indian economy in the beginning of 90's made Indian industries to look outward. Increasing competition due to liberalization, privatization, and globalisation has compelled Indian industries to develop export market. Even in the domestic market, Indian manufacturers have to compete with world-class competitors. It is, therefore, imperative that Indian manufacturers achieve world-class performance in order to survive in the domestic market and to compete successfully in the export market. Indian manufacturers have to make quantum improvements in their manufacturing practices. Benchmarking could be an appropriate tool to make such a transition.

World-Class Manufacturing

World-class manufacturing (WCM) is commonly understood as "advanced manufacturing techniques that can be adapted and used to elevate a facility's manufacturing performance to world-class levels" (Rubrich, et al, 1998). Quite often Japanese manufacturing techniques like TQC, JIT, TPM, etc. are regarded as advanced manufacturing techniques, an application of these techniques implies world-class manufacturing. Subsequently, different techniques like CAD, CAM, etc. have also been added to the above set of techniques to be regarded as world-class manufacturing. In fact, Schonberger (1986) who coined the term WCM has included several of these techniques. However, subsequently different authors have included many techniques under different labels of improvement initiatives in operation as given in Table 1.

On perusal of the different tools and techniques mentioned one could easily see no major differences among tools and practices that are covered under WCM and those which are not. It is, therefore, believed that any of these improvement initiatives could be classified under WCM provided its application could lead to world-class level of performance in manufacturing.

Table 1: Improvement Initiatives in Operations

Authors	Term	Initiatives studied
Schonberger (1986)	WCM techniques	CIM, FMS., CAD, CAE, TQM, TQC, JIT production, supplier development, employee involvement, manufacturing strategy.
Gunn (1987)	New technology practices	CIM, FMS, AS/RS, CAD, CAE, CAPP, TQC, JIT, improve supplier quality, human resources, manufacturing strategy.
Hayes et al (1988)	Dynamic manufacturing	Learning, human resource management, CAD/CAM, JIT, information flows, flexible automation.
Ettlie (1988)	Technical, organisation innovations	CIM, CNC, FMS, CAD, CAE, CAPP, quality systems, JIT in purchasing, suppliers, human resources.
Womack et al (1991)	Lean production	Relations with suppliers, relations with customers, concurrent engineering, JIT, improvements.
Giffi et al (1990)	Best manufacturing practices	Manufacturing cells, CAD, CAE, quality management, JIT, partnership, human assets, manufacturing strategy.
Aggarwal (1995)	Hard technologies, Soft technologies	CAD/CAM, FMS, CIM, JIT, TQM, concurrent engineering, total productive maintenance.
Hupton (1995)	Operations improvement, Process elements	Training, focussed team initiatives, new processes and tools, organisational change, knowledge development.
Bates and Flynn (1996)	Manufacturing Process innovation	Cellular manufacturing, CAD, CAM, TQM, JIT, supplier management, employee involvement, manufacturing strategy.

Source: Filippini, et al, 1998.

Tools and techniques could be effective in delivering performance results when these are supported by a consistent set of values and practices. So, values or principles (i.e., a kind of mindset possessed by a dominant group in an organisation), and tools (i.e. a part of actions) are inter-related to one another (Boaden, 1997). Many authors have, therefore, characterised WCM in terms of values and practices. These values relate to "the way in which people view their work and the philosophy that encourages them to seek out the improvement" (Hayes, et. al., 1996, p. 705). One of the well known internet sites (Source: 'What is world class all about') has mentioned six beliefs and values

viz, Quality, Customer as focus, Continuous improvement, Employee involvement, Partnership with stakeholders and Integrity.

Kinni (1996) characterizes WCM by Three Core strategies of Customer focus, Quality and Agility and six supporting competencies of Employees:

- Supply management
- Technology
- Product development
- Environmental responsibility
- Employee safety
- Corporate citizenship

Similarly, Huge and Anderson (1989) mention two dominant practices to deliver WCM – continuous improvement and elimination of waste. Maskell (1991) talks about following practices to comprise WCM:

- Focus on Process quality
- Just in time production techniques
- Workforce management
- Flexibility in meeting customer requirements

Kasual and Motwani (1995) have identified a set of organisational requirements or critical factors for WCM implementation. These factors are given in Table 2.

Practices or principles are said to be applied effectively when their applications result in improvement in performance. Schonberger (1986) states that "world-class manufacturing has the goal of continual improvement in quality, cost, lead time and customer services as also the flexibility." Hayes, Wheelwright and Clark (1988) identify following key performance attributes of WCM.

- Becoming the best competitor. (Being better than almost every other company in the industry, in at least one aspect of manufacturing.)
- Growing more rapidly and being more profitable than competitors.
- Hiring and retaining the best people.
- Developing top notch engineering staff.
- Being able to respond quickly and decisively to changing market conditions. (Being more nimble than one's competitors in responding to the market shifts, pricing changes or new product development.)

Table 2: Critical Factors for WCM

Factors	Definition
Management commitment	A dedication to empowering people to change; formulating policies, strategies and monitoring the progress to ensure that core manufacturing strategies and business strategies are deployed.
Quality	Utilizing a quality policy and plan to improve current manufacturing capabilities and transfer authorship of quality to the employees who produce it. Using quality cost data in design of new products and development of processes. Benchmarking information to improve.
Customer satisfaction	Implementing internal and external customer assurance plans including dependable information, rapid response to complaints, and teams of cross-trained workers empowered to implement suggestions for improvement.
Operations flexibility	Incorporating time-based strategies in manufacturing operations leading to rapid response of customer order requests and rapid introduction of new products. Installing methods and reporting structures that allow reduction in manufacturing lead times.
Innovation and technology	Incorporating innovation into the corporate culture. Encouraging new ideas, processes and solutions by all employees of a firm. Concentrating on state-of-the-art technology and new applications for use in innovative ways. Reducing cycle and set-up times.
Facility control	Utilizing cell layouts for efficiency, concentrating on waste elimination and housekeeping efforts. Implementing a preventative maintenance plan. Optimizing space needs to allow for future growth and less non-value added activities.
Vendor management	Strengthening relationship with suppliers resulting in lower inventory levels and cost, and higher accuracy and turnover. Involving vendors in the design process and technology and response needs of the business. Selecting vendors based on quality and delivery rather than cost alone.
Price/cost leadership	Lowering unit manufacturing costs for competitive market demands. Responding to customer request for higher value and quality products with more features.
Global competition	Researching and benchmarking global competitors. Developing and deploying strategies that market core competences.

Source: Kasul, et al, 1995.

- Adopting a product and process engineering approach which maximize the performance of both.
- Continually improving.

Gunn (1987) suggests a number of criteria for evaluating a company's world-class manufacturer status, such as inventory turnover, quality defects, and lead time.

An influencing section of academicians, led by Harvard Business School of U.S.A., prefers to look at WCM with a holistic perspective (Hayes, et al, 1994). According to them, a distinct manufacturing 'capability' in an intended direction offers a competitive advantage to make a firm successful to compete in a turbulent environment. 'Capability' combines ability and competence (Hayes, et al, 1996, p. 505). When the ability of an organization to achieve cooperation and coordination with a team of resources reaches a high level of perfection through repetition, capability is developed. Specific kind of such capability delivers competitive advantages. WCM should therefore be seen as a level of achievement as one understands technical excellence on mini- Engines with the Honda and the product development capacity with 3M corporation (Grant, 1991). Giffi, Roth and Seal (1990) also define WCM from the same angle. They view it as a "dynamic process that provides unique values, competitive advantage and delight to customers and suppliers through the development of internal operational capabilities that foster continuous improvements in human assets, technology, materials and information flows, that are synergestic with the total business".

WCM is a dynamic process that provides unique values, competitive advantage and delight to customers.

In the light of capability–centered theory, one could now understand WCM being a level of manufacturing capability. Blackmon et al (1999) has recently defined it as "the point at which a certain standard of practices and performance has been obtained equaling or surpassing the very best of international competitors in every area of a company's business such that the company has achieved international leadership and success". And naturally the referred point will keep on changing. Based on a study, termed as 'Made in Europe', conducted by London Business School and IBM consulting group, a firm may be recognized as a world-class manufacturer if it reaches 80 per cent of 'benchmarks' in terms of both practices and performances. Fig. 1 shows the related matrix display. Firms placed at different points on the matrix are known by various labels. These 'benchmarks' are based on assessments of practices and performances as followed in the study. Hence, one could see a vital role of benchmarks and benchmarking in the conceptual framework of WCM itself.

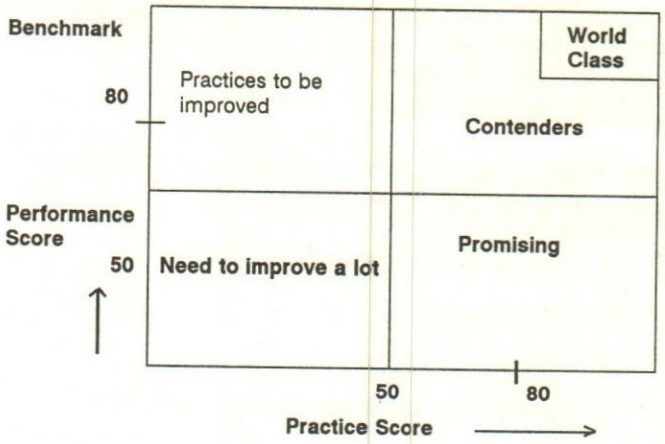

Fig. 1. 'Made in Europe' model

Benchmarking

Benchmarking is a term coined by xerox Corporation. Webster's ninth new collegeate Dictionary defines benchmark "as a point of reference from which measurements may be made or something that serves as a standard". The most often quoted definition is attributed to the CEO of Xerox., David Kearns: 'Benchmarking is the continuous process of measuring products, services and practices against the competitors or those companies recognised as industry leaders' (Fitz-enz, 1993, p. 26). Camp, the first author of a book on benchmarking, regards benchmarking as an investigative process to search for industry best practices that lead to superior performances, (Camp, 1989). But benchmarking is not understood uniformly.

Spendolini (1992) has found out fourty nine definitions. Many look at benchmarking as an organised method for quoting data to make comparison for finding out a gap. Others see it as a tool that promotes learning and stimulates organisation changes (Bogan & English, 1994). American Productivity and Quality Centre has defined it as "a process of identification, learning and adapting a superior practice from others" ('WWW .apqc.org'). According to them, benchmarking is essentially an action. Benchmarking includes implementation whereas traditional method of benchmark setting is an intellectual process.

In line with such a diversity in interpretation of benchmarking, there are many kinds of benchmarking that have been listed in the literature. However, a consensus is gradually emerging to the effect that the following four kinds of benchmarking could be sufficient to cover the whole spectrum (Watson, 1992; Bogan & English, 1994; Pettersen, 1995; Yarrow, 1999):

- Performance benchmarking
- Diagnostic benchmarking
- Process benchmarking
- Strategic benchmarking

Performance benchmarking is a comparison of metrics among two or more number of organisations. It provides a gap in performances which could be subsequently analysed for finding out an appropriate improvement action. This is the most understood and used meaning of Benchmarking.

Diagnostic benchmarking consists of measuring performances and practices with reference to predefined set of performances and practices and subsequently profiles out areas for improvement.

Process benchmarking, which is alternatively known as 'Best Practice Benchmarking' not only finds out the gap but also finds out enabling factors and underlying processes that contribute to superior performances. Process benchmarking finally results in formulation of an action plan to be taken up for implementation. This is what has been increasingly recognised as 'true' benchmarking with considerable potentiality.

Strategic benchmarking compares strategies and policies pursued by different companies and helps the company under reference to adapt an appropriate policy which serves it the best.

Considering all the above definitions, it is clear that benchmarking is a tool that helps an organisation to improve its functioning by letting it know the gaps, areas for improvements and even superior practices to be adopted for improvement. Manufacturers in the developed countries have been using one or other kinds of benchmarking to improve their manufacturing performances.

Benchmarking is a tool that helps an organisation to improve its functioning by letting it know the gaps, areas for improvements and even superior practices to be adopted for improvement.

Performance Benchmarking

Performance benchmarking concerns with a comparison of performance levels. (Pettersen, 1995) Manufacturers compare performance measures of their total manufacturing systems or of their parts against those of their global competitors. Recently, Ahmed & Benson (1999, p. 1) have defined benchmarking per se in a manufacturing context as a "structured process comparing the performance of similar manufacturing assets against the best in the world, with the intention of learning and hence continuously improving". Operational benchmarking, a variant of performance benchmarking, compares one's own micro-operations with another's using physical clearly measurable characteristics such as lead times, variable costs, yields, defects, physical inventory level, etc. (Hayes, et al, 1996), Physical measures tend to be more creditable and clearly understood than financial measures. Performance measurement model, thus, used in performance benchmarking differentiates its applications.

There are a number of performance measurement frameworks that are either in use or could be considered for future applications. Framework wise applications are as follows:

Du pont's financial ratio structure based benchmarking, which is termed as 'Interfirm Comparison' is the oldest and most widely used one since 1950's but at the firm level. Manufacturing business units all over the world are using this framework to analyse financial performances.

Process measurement framework in the form of quality, cost, time or in terms of manufacturing competitive priorities – cost, quality, dependability, flexibility and innovativeness has been increasingly used since 1980's by both researchers and practitioners. Garvin (1983), Womack et al (1990), Andersen consulting (1993) and MIT/Sloan Foundation have investigated various aspects by carrying out such kind of benchmarking in industries like Automotive, Auto-component suppliers, Air conditioners, semi-conductors, computers, steel, etc. Some of the outstanding manufacturers in the world are also documented to have been using such benchmarking effectively (Neely, et al, 1996). For example, Chaparral Steel, USA compares itself regularly with the best steel makers in the world in terms of cost, quality, service and technology and not just domestic competitors (Edmondson & Wheelwright, 1989). On the basis of a benchmarking study, Daewoo shipbuilding and Heavy machinery, Korea, regard themselves as the fastest improving shipyard in the world (Hayes, et al, 1996). The Britain's Best Factories Award, run by Management To-day/Cranfield School of Management since 1992, has been using such benchmarking framework.

Total Productivity Measurement framework espe-

cially as developed by Sumanth (1984), Prem Vrat et at (1998), etc. has drawn considerable attention in recent times. These models have been used for productivity diagnosis especially in developing countries like Phillipines, Singapore, etc.

Frameworks based on Total Quality Award Schemes: Malcolm Baldridge National Quality Award (MBNQA) model, European Foundation of Quality Management (EFQM) Model, etc, provide opportunities for performance benchmarking among globally competing firms. Lobo and Zairi (1999) have used EFQM model to carry out competitive benchmarking in the air cargo freight industry. But large scale use of these models does not still exist. Similarly, Balanced Score card based framework as developed by Kaplan and Nortan (1992) is yet to be exploited for such benchmarking.

Performance measurement based frameworks provide variations in performance benchmarking, Non-financial measures at an micro-operational level of manufacturing are going to be increasingly used for performance benchmarking.

Diagnostic Benchmarking

Diagnostic Benchmarking differs from performance benchmarking in a sense that the former encompasses a set of interrelated practices along with performance measures which alone are covered in the latter. Applications of such diagnostic benchmarking vary primarily with frameworks that determine the criteria and assessment procedures for those pre-defined practices. Framework wise applications are as follows:

Applications of diagnostic benchmarking vary primarily with frameworks that determine the criteria and assessment procedures for pre-defined practices.

Quality Control (QC) diagnosis reports, provided by Deming Prize award committee to participating Japanese manufacturers since 1950's, may be cited as the earliest example of diagnostic Benchmarking for WCM especially in respect of Company Wide Quality Control (CWQC). More comprehensive Total Quality Awards and Business Excellence models have come into being in almost all the developed countries since the end of 1980's. A large number of manufacturing organisations are using these models to evaluate their strengths and to identify areas of improvement. Those scoring 70 per cent as per the evaluation system of

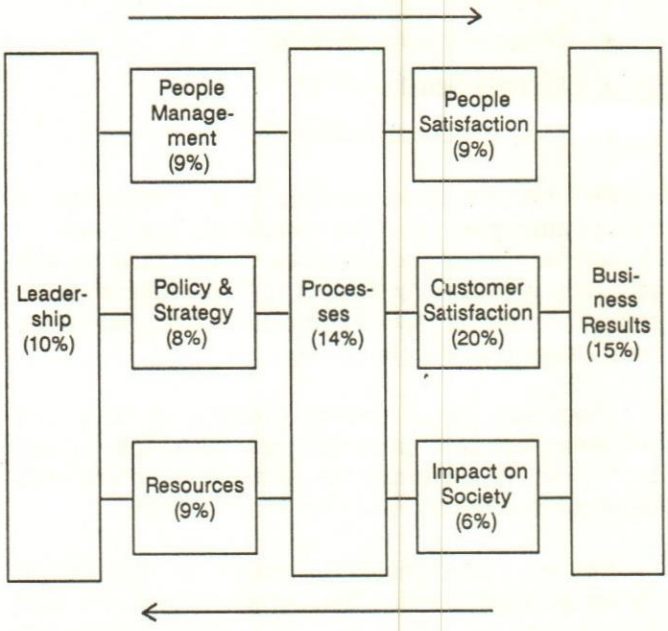

Fig. 2. EFQM model for business excellence

those models are normally recognised as world-class organisations. Explicit assumptions are held in all these models to the effect that better practices drive higher results. A typical EFQM model, which was introduced in 1992 in Europe consists of nine interrelated elements/criteria as shown in Fig. 2. A systemic self-assessment procedure is followed in evaluation of individual elements of the model. The result is a score between 0 and 1000. This model is claimed to have been greatly facilitating European manufacturers to become world-class manufacturers (EFQM, 1999).

Schonberger model: Schonberger (1986), a world renowned author and consultant on WCM has brought out an assessment model to find out the extent of application of WCM principles and practices. He has identified 16 core principles and practices as follows:

- Team-up with customers/organise by families of customers or products what customers buy/use.
- Capture and apply customer, competitive and best-practice information.
- Dedication to continual rapid improvement in quality, response time, flexibility and value.
- Involve frontliners in change & strategic planning—to achieve strategic purpose.
- Cut to the few best components, operations and suppliers.
- Cut flow time and distance, start up/change

over times all along the chain of customers.

- Operate close to customer's rate of use or demand.
- Continually enhance human resources through training and job rotation, for their new role.
- Expand variety of rewards, recognition, pay and celebration to match the expanded variety of employee contribution.
- Continually reduce variation and mishaps.
- Front line teams to record and own process data at workplace.
- Control root causes of cost and performance, thereby reducing internal transactions and reporting, simplify external communication.
- Align performance measure with the universal customer wants—quality, speed, flexibility & value (qsfv).
- Improve present equipment and human work before considering new equipment and automation.
- Seek simple, flexible, movable, low-cost, readily available equipment and work facilities—in multiples, one for each product/customer family.
- Promote, market, and sell your organisation's increasing capability and competence—(every improvement the result of other fifteen principles).

He rates the extent of application at a site in respect of each of these principles in 0 to 5 scale. Though this assessment model is quite comprehensive, evaluation by this model appears to include considerable amount of subjectivity. However, this model has been widely used as a benchmarking tool for WCM.

Shingo Prize Model: Like Total Quality Awards models, another award that evaluates excellence in manufacturing exists to find out strengths and weaknesses. This model, called Shingo Prize model for manufacturing, has been extensively used in USA, Mexico and Canada since 1989 (Utah State University, 1996). Fig. 3 gives the framework for this model. As shown in the model, leadership and relationships with other stakeholders are the basic drivers for making various initiatives successful. Manufacturing strategy, use of various so called WCM tools and techniques and interlinkages with other non manufacturing functions form the core aspects of the manufacturing excellence. However, this model is also criticised for not having given sufficient importance to performance results as well as for having considerable amount of subjectivity in evaluation.

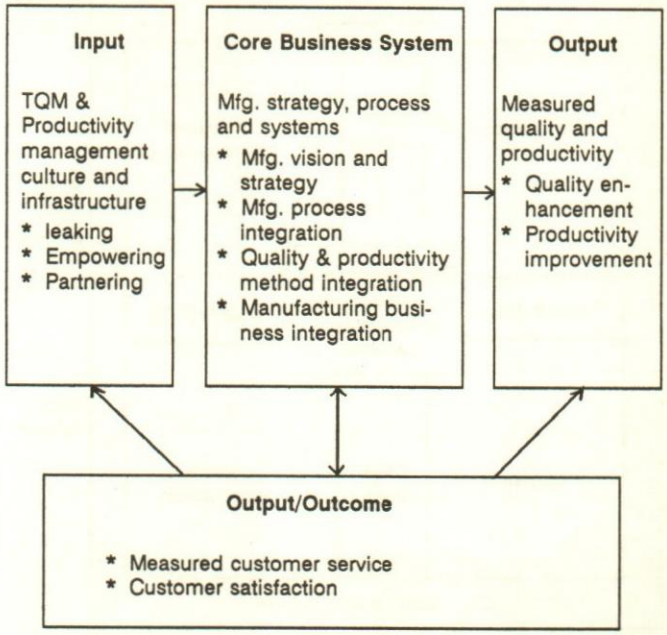

Fig. 3. Shingo's Model for Manufacturing Excellence

PROBE: "Made in Europe", a report prepared by IBM consultants and the London Business School (Hanson, et al, 1994), has provided a unique tool for diagnostic benchmarking. The tool, which is known as PROBE (Promoting Business Excellence) has been increasingly used in Europe to assess the strengths and weaknesses. This tool is based on a simple assumption which has been extensively validated with the help of statistical data collected from more than 700 organisations. The assumption is that an adoption of best practices in consistence with both Japanese manufacturing concepts and the customer—driven quality ethos of Baldrige and EFQM (Blackmon, et al, 1999) will build up world-class manufacturing capability. The key components of the model as shown in Fig. 4 are characterised as follows:

Organisation and culture: With obvious leadership from the chief executive, a clear vision for the business is jointly developed and shared throughout the site. Employees are inspired to follow the direction set and are encouraged and trained to take responsibility for its achievement. The measurement of the business is displayed for all to see.

Logistics: Relationships with suppliers are built on the assumption of lasting partnerships. The benefits of joint activity leading to lower total supply chain costs are shared. Outbound logistics are capable of delivery into, for example, highly variable just-in-time retailers.

Manufacturing systems: Information technology

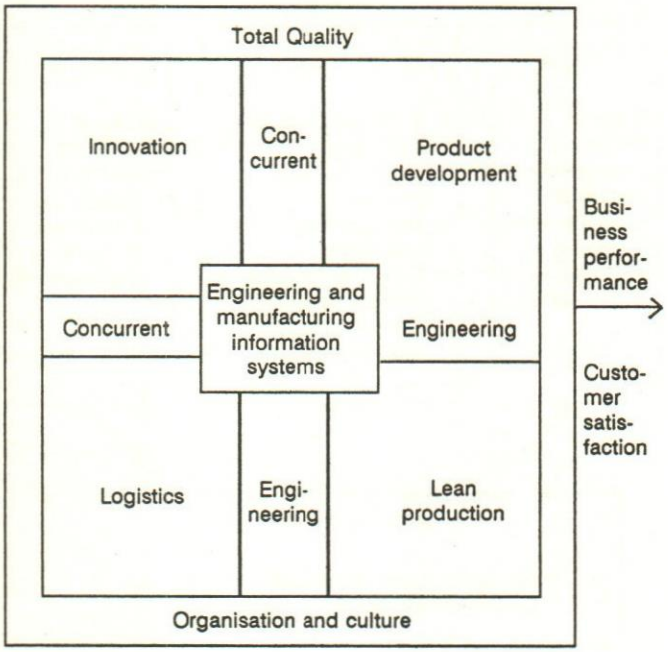

Fig. 4. Best practice model of World-Class manufacturing

Source: Blackmon, et al, 1999.

systems are integrated so that the design process delivers a workable bill of materials to the planning process; for example, CAD and CAM can realistically be spoken of in the same breath.

Lean production: Every aspect of the manufacturing process that adds cost but not value is systematically eliminated (e.g. unnecessary movement, counting, inspection, paperwork etc.)

Concurrent engineering: The design and development process involves suppliers and customers as well as manufacturing and sales teams. The product will not only meet customer requirements but will also enable optimum manufacturing and distribution.

Total quality: With all business processes sharply focused on meeting and exceeding customer expectations, a spirit of continuous improvement pervades the entire business.

Product development: occurs within empowered project teams using well defined reproducible processes which incorporate continuous improvement achieving 20 per cent annum cycle time improvements.

Innovation: is considered as a part of the organisation's culture and is encouraged with customers being involved in the development of concepts.

Since the publication of the "Made in Europe" report, coverage of the data base has been extended. There have been more than 1000 sites surveyed and additional uses are active in Canada, South Africa and USA. In addition, a separate but a very similar initiative known as 'Microscope' has been developed in 1996 to target at small scale industries. This tool might have, by this time, covered more than 300 units in the Europe itself.

Ahmad & Benson Model: Based on the same fundamental hypothesis – the adoption of best practices will result in strong operational performance (Hanson, et al, 1999), Ahmad and Benson (1999) have developed a benchmarking framework for world-class manufacturing in process plants. The said framework is qualitatively described as follows: A world-class process manufacturing plant delivers outstanding customer service from reliable assets exhibiting operational excellence. It is operated by highly-motivated people and always maintains its licence to operate by satisfying the high safety and environmental standards of the process industries (Ahmad & Benson, 1999, p. 3).

This framework involves measurement of following three aspects:

- measuring the output of the process which is the performance in all its dimensions.
- measuring the input practices that area applied to deliver these outputs.
- measuring the culture and softer issues that ensure that the practices are applied and the performance is delivered.

This framework has been used for benchmarking over 200 process plants in many countries.

Basu & Wright Model: Besides above mentioned frameworks that have been widely popular in developed countries, academicians and management consultants have also evolved many such models for diagnosis towards achieving world-class manufacturing. One of such frameworks that have been recently established by Basu and Wright (1997) is the most comprehensive one but easy to use. It has 200 questions to be filled up. It is based on a model defined by them as a total manufacturing solution. Total manufacturing solution is the systematic process of measuring all aspects of manufacturing business. The key categories of items included in this model are:

- Marketing and innovation
- Supply-chain management
- Environment and safety
- Manufacturing facilities

- Procedures, and
- People

As shown in all the frameworks mentioned, assessment of processes and practices is a key issue for diagnostic benchmarking. 'Best Practice Model' of world-class manufacturing as shown in Fig. 4 is the most popular benchmarking tool for world-class manufacturing.

Process Benchmarking

Through process benchmarking, organisations learn by discovering how others operate and then trying to adopt and adapt this knowledge into their own organisations. It is essentially an adaptive innovation. It not only finds out a gap in performance but also enables an organisation to understand technologies, practices and other factors that sustain better performances. An outstanding manufacturer, Chaparral Steel of U.S.A. is known to have been systematically nourishing relationships with steelmarkers in Europe and Japan in order to benchmark. The company arranges regular visits to observe and learn from them. A typical practice is to send a small team (an operator, a supervisor, an Engineer and a maintenance technician) to talk with their counterparts at the target site. The team gathers data on parameters such as equipment cycle times, yields and inventory levels, but also examines practices and methods to understand what lies behind the observed performance (Edmondson & Wheelwright, 1989).

Though process benchmarking started becoming popular since early 1980's, its large scale application got into way only from end of the said decade. MBNQA provided a big impetus in its use especially in U.S.A. Today almost all the fortune 500 companies have been applying benchmarking. Some of these companies like Xerox, Milliken, Eastman Kodak, etc. have developed organisation wide infrastructure to facilitate process benchmarking. Firms in most of the developing countries are yet to adopt it effectively though they would require it the most. However, as a part of a recent world wide research study on 'Organisational Learning Capability', Yeung et al (1999) have illustrated a case of successful benchmarking by a Korean firm in a challenging environment. Confronted with odd demands from key customers, Samsung Electronics (SEC) decided to introduce a Flexible manufacturing System (FMS), one of the so called WCM practices, in its production lines in 1990. FMS was then completely new in Korea. Organisational environment prevalent then in SEC was also not conducive for working with FMS. But SEC undertook a systematic and aggressive benchmarking initiative in many fronts. It encouraged employees to learn FMS from academic sources. The company created joint ventures with exemplary Japanese and U.S. firms. For example, SEC exchanged a technology of making DRAM Chips for Toshiba's FMS knowledge. It also insisted on the transfer of FMS expertise as part of its sales agreement with targeted customers. It entered into strategic alliances with small and mid-size foreign firms. Finally, its employees mastered the working of FMS. Gradually, SEC also flattened its organisational structure and evolved a new culture with emphasis on employee empowerment and involvement. After successful introduction of FMS in one of its production plants, SEC has now been gradually transferring the knowledge gained to its other plants. Benchmarking has thus been the dominant style of learning in this case to introduce WCM technically and culturally as it should be.

Every process benchmarking has got four key steps:

- Benchmark WHAT?
- Who/What is BEST?
- How do THEY do it?
- How do WE do it?

There are two predominant frameworks for process benchmarking existing in the world, though each of those models centers around these basic steps. The framework normally followed in U.S.A. is typified by one used by International Benchmarking clearing house of American Productivity and Quality Centre (Zairi, 1996) A study is conducted through following stages for each process selected by a company:

Planning a study: The selected process is analysed and a questionnaire is prepared.

Collecting data: Secondary search is made to find out a partner and a visit is made.

Analysing data: Performance gap and enablers are identified and a case study is made.

Adapting and improving: Action plan is prepared and the same is implemented by a team which is especially formed.

In this 4–step process–centered methodology, selection of a process, availability of a partner and collection of process information at a partner's end are the critical factors. Most of the successful companies have been extending their cooperation in U.S.A. to benchmark one another under certain codes of conduct.

The second framework heavily depends upon Total Quality Award models like EFQM, MBNQA, etc. as mentioned. Best practices in all the areas covered in the model are collected through self-assessment by the company executives and the same are shared with those wanting to improve upon in the same area (Mann, 1998). This framework has been increasingly gaining familiarity in Europe, Australia, Singapore, etc. (APO, 1997).

Irrespective of the framework, process benchmarking provides a knowledge to fill up the performance gap. It stimulates an innovation. It is believed to be most useful for laggards. However, TQM based improvement culture should be prevalent in the organisation in order to derive maximum benefits out of process benchmarking.

Strategic Benchmarking

Strategic benchmarking provides strategic data information that can be compared to similar information from other global manufacturing companies. PIMS (Profit impact of Market Strategy) data base, comprised of data from 3000 business units all over the world, provides several useful benchmarks to an organisation in different functional areas (Bazzell & Bradley, 1987). But a special mention needs to be made to an emerging database that is being built up since 1981 to provide information about manufacturing strategies pursued by global manufacturers. (Miller, et al, 1992). The data base is updated periodically as a part of 'Global Manufacturing Futures' research project. This data base deals with data on competitive manufacturing priorities, effectiveness of different initiatives, etc. in U.S.A., Europe, Japan and a few Pacific countries. More than 1000 manufacturing companies in these countries are regularly participating in the project and benchmarking strategic aspects of manufacturing with others. Strategic benchmarking helps companies to select processes where process or performance benchmarking could be effectively applied to achieve competitive advantages.

Strategic benchmarking provides strategic data information that can be compared to similar information from other global manufacturing companies.

Benchmarking in India for WCM

It is during the later part of 1990's that the term 'Benchmarking' has become popular in India. A few visits by Robert Camp, world renowned Benchmarking 'Guru' as well as some of the promotional activities led by National Productivity Council (NPC) have made the term known to Indian organisations. However, the term has been interpreted a little differently by different Indian organisations. It is to be noted that most of the Indian manufacturing organisations have been mostly active in realigning their quality management systems with ISO-9000 certification requirements as a part of TQM drive during the same period (APO. 1998). There has been very little improvement culture prevalent in the country. It is, therefore, no wonder that benchmarking has been understood by most of the organisations as a tool mainly for setting up targets (Nandi & Banwet, 1999). But there is a handful of organisations who undertook benchmarking for performance improvement. Nandi and Banwet (1998) have used it extensively in planning for re-engineering an Indian not-for-profit organisation.

Based on the available literature and case study materials under preparation, performance benchmarking has been found to be the most popular among forward looking organisations. Mostly multi-national organisations and a few large Indian organisations have been carrying out such performance benchmarking at a global level to become World-class Manufacturers. For example, multi-nationals like Gillete, Smith Kline Beecham, etc. have been benchmarking with their other national organisations belonging to the same parent bodies. They compare performances in terms of quantitative data to find out the gaps. Gaps are then subsequently discussed with selected national organisations to find out steps required to be taken to improve the performance. Some of the Indian organisations like Indian Oil Corporation, Jindal Steel, etc. have engaged multi-national consulting firms to benchmark their operations to find out gaps. Internal groups are then formed to find out actions for improvement in the performance.

So far as diagnostic benchmarking is concerned, very few have applied it for finding specific areas for improvements. There are three or four organisations who are working to get Deming awards. Only one company – Sunderam Clayton Ltd. has already got Deming awards in India. There are two dozen Indian organisations who are said to have been working towards WCM by undertaking periodical self-assessments through the EFQM model. Two organisations till now have been found to be reaching more or less towards World-class manufacturing status (CII, 2000).

There are very few Indian organisations including Indian subsidiaries of multi-nationals that have been applying process benchmarking framework to improve upon their processes. Modi Xerox and Tata Steel are two typical examples which have been continuously

pursuing process benchmarking methodology. Alstom has also been active in promoting such initiative. However, a number of Indian organisations especially in the auto-component sector have been conducting benchmarking informally with their collaborating firms in order to learn their practices and processes.

Conclusion

World-class Manufacturing essentially refers to achievement of globally competitive manufacturing capability through continuous improvement with involvement of employees by adaptation of various operational improvement tools and techniques. Application of such tools and techniques requires a change in the corporate culture and value systems. Mechanical application of those tools may not be effective in getting results to the desired extent. On such realisation, a few forward looking Indian firms especially in sectors with higher competition have been building up a culture of learning and improvement. Benchmarking, being a structured method of effective learning, is finding wider acceptance by these Indian organisations.

Besides informal benchmarking which is more common, performance benchmarking has been the most widely utilised both globally and in the country. Such benchmarking provides the gap in performances which could be, subsequently, subjected to analysis through a problem solving structure. Many Indian companies are carrying out performance benchmarking with the help of consultants which have accessibility to global data base in the concerned area. However, multi-national corporations and their subsidiaries are carrying out benchmarking with their counterparts a little more easily than others. Diagnostic benchmarking which has hitherto been popular in Europe is gaining acceptance in other continents. Increasing popularity of EFQM model based self-assessments are now accepted to play an important role in the country to carry out diagnostic benchmarking. A few organisations in India who have achieved certain amount of distinction in implementing comprehensive TQM process are expected to initiate fruitful applications of process benchmarking.

Regardless of any specific structure for benchmarking, many Indian organisations are on the path of learning from others to become world-class manufacturers. Finally, it could be concluded that benchmarking could contribute greatly to bring about world-class manufacturing capability. Several models and frameworks that are existing to carry out benchmarking for manufacturing excellence validate the above assertion. Indian manufacturers should, therefore, look at benchmarking as an essential performance improvement tool and pursue the same effectively to become world-class manufactures.

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Acknowledgment

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Benchmarking & World Class Manufacturing for Competitive Advantage

Ajay Pandit, K.K. Khanna & Yun Jing

In the face of an increasingly turbulent and hostile environment firms are finding it difficult to sustain their competitive advantages in the marketplace, eg, the best quality product, the lowest product cost, the shortest lead-time, the best customer service. Mere incremental improvements are no more the concern of the managers. Today they look and aim for breakthrough achievements. Integration of WCM and Benchmarking offers tremendous opportunities for attaining distinctive capabilities and competitive advantages. In this article an attempt is being made to explain the emerging concepts of World Class Manufacturing and Benchmarking, the integration of which provides today's leading manufacturing organisations with a powerful set to improve competitiveness.

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The irreversible process of liberalisation started a decade ago has speeded up with the beginning of the new millennium. The marketplace has become truly global. There is increasing fragmentation of almost all markets. Customers require smaller quantities of customized products as they want to be treated individually. Most companies having much wider product ranges, are introducing new products quickly in a focussed manner. Information technology driven changes are ushering in new and exciting challenges for the Indian manufacturers. Competitive forces require the firms to deliver superior value to the customers. Advantages go to the firm that can quickly rethink its strategy for winning while adapting to frequent changes in the competition. Small and agile information based entrepreneurial firms now run neck to neck with giant organisations endowed with deep pockets and huge resources (Fahey, 1999). Winning in the marketplace is not measured in terms of financial parameters alone. Factors that help inspire loyalties amongst the participants of the business system have assumed more importance. Profit is indispensable, of course, but it is nevertheless a consequence of value creation for the customers. Equally important is the value creation for the employees, investors and stakeholders who are the other participants of the business.

In the last few years, manufacturing operations have been managed and controlled through the use of tools and techniques, such as formal production and materials planning, shop floor scheduling and control, and systems like MRP (Manufacturing Resource Planning) and ERP (Enterprise Resource Planning), with varying degrees of success. TQM (total quality management) methods were implemented to bring the processes under control and create continuous improvement.

However, of late everything is changing very fast

and unpredictably. Customers require low volume, high quality and customised products. These high quality customised products have very short life-cycles, therefore very short development and production lead times are required. Further, mass production manufacturing techniques have very bleak future in some of the Industries. This has led to a people intensive, relationship driven operations. Perfect quality and high levels of service are expected and required. Products and services have become information-rich. Customers have virtually forced the firms to provide greater flexibility, shorter lead times, and more varied products and services. To survive in the fast changing environment, Indian organisations have no option except to learn and imbibe the best practices of world class organisations.

The benchmarking concept was created by Rank Xerox when they found that Japanese competitors were selling copiers at Rank Xerox's manufacturing cost price. The Americans investigated, they went to Japan and learned about the practices of their competitors. They then worked to improve their own practices relative to the Japanese. This investigation and learning process has come to be known as benchmarking and the operational practices they saw in Japan are now known as World Class Manufacturing.

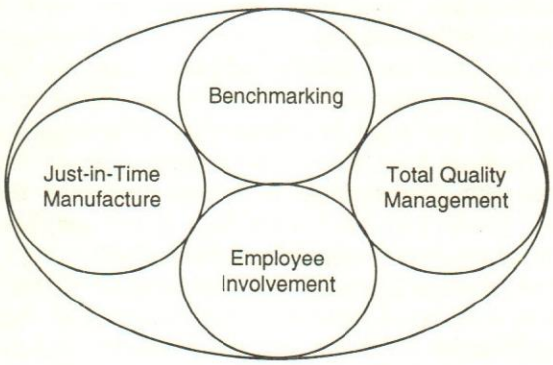

Fig. 1. Benchmarking Concept

World Class Manufacturing

World class organisations have to be visionary firms which are "crown jewels" in their industries and are widely admired by their peer group and have a long track record of making a significant impact on the world around them (Collins & Porass, 1998). To be a world class organisation, the firm does not have to operate worldwide or even nationwide. It may be a small local organisation which leads in its area fields, embraces and actively demonstrates the characteristics of world class performance. According to Joyce (1995), world class performance maintains continued success through the development of an organisational environment that is distinctly different to peer and competitor firms in its philosophy and wealth creating formula.

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The term WCM has come to mean the pursuance of best practice in manufacturing. WCM is a term that is now widely recognised in manufacturing industry but there is still some confusion about what it actually means (Schonberger, 1986). A company making the transition to WCM must undergo many changes. It may have to change its organisational structure, machine layout, maintenance procedures, quality systems and almost every other system in the company. When faced with the magnitude and scope of these changes managers often find it difficult to decide where to start. This is a critical decision because if they begin badly, the attempt to implement WCM will probably end in failure. It has been estimated that up to 70% of change programs fail to achieve their objective (Keegan, 1995).

Better, cheaper, faster.... These are more than buzzwords in successful manufacturing organisations worldwide. To compete and to win in today's marketplace requires manufacturers to improve productivity while lowering costs and bringing quality products to market quicker than ever before. Today manufacturing strategy must support overall business strategy and indeed, many companies are looking to manufacturing to give them competitive advantage in the marketplace, eg, the best quality product, the lowest product cost, the shortest lead-time, the best customer service. WCM is a way of achieving this competitive advantage from manufacturing. It is the pursuit of superior performance in quality, lead-time, cost and customer service through continuous improvement using principles such as Just-in-Time manufacturing, total quality management and employee involvement (Fig. 1). World class companies optimise the problem solving abilities of their employees in applying both modern techniques and traditional industrial engineering techniques.

WCM : Features

WCM concept, traditionally, covered such diverse areas as:

- Just in Time Manufacture

- Total Quality Management
- Employee Involvement.

Just-In-Time (JIT) is closely related to "Lean Manufacturing" which takes this philosophy a stage further by attempting to eliminate waste in all areas of the organisation. Total Quality Management (TQM) ensures the customer's needs are identified and that systems are put in place to satisfy them. Customers can be external (the final customer) or internal (the next operation). Employee Involvement (EI) means that employees are given a chance to become involved in the decision making process.

Total Quality Management (TQM) ensures the customer's needs are identified and that systems are put in place to satisfy them.

Even though the world class manufacturing and best practice approaches are based upon the time-honored concepts of mass production of standard products, a truly world class manufacturing organisation, in today's turbulent environment, shall have to be agile as well, to serve customers with small quantities of custom designed parts with perfect quality, hundred percent on-time delivery, and at very low cost. Agile manufacturing requires the company to be world class and using lean manufacturing methods. This is the starting point. In the consumer electronics and automotive industries the need for agility is most apparent. New products are coming very fast. The range of products is increasing at an astonishing level. The customers and markets are becoming continuously more fragmented and specialized. Only the innovative and agile companies will survive these changes. Every product comes in a bewildering variety of sizes, packs, and variations (diet, low sodium, decaffeinated, and so forth). All of these trends lead away from the old ideas of large factories making huge quantities of relatively few standard products.

Other industries will need a few more years before these changes begin to bite, but already the pharmaceutical industry, the metals industries, garments, and many others are seeing the start of these trends through product proliferation and increased customer requirements for custom products.

Fundamentally WCM is about Leadership. If a company is serious about WCM its managers will act in a different way from those in a traditional company. Most managers are familiar with production bottlenecks and their effect on the operation. However, there is another type of bottleneck that can reduce the company's effectiveness significantly but is rarely identified because it is accepted as part of the system. This is the decision bottleneck. When all the decision making power is concentrated in a few individuals they find it impossible to cope effectively with the sheer volume of decisions, explicit and implicit, that must be made. As a consequence, they usually concentrate on operational decisions, particularly urgent ones, and the important tactical and strategic decisions are never made. The company suffers as a result. Empowerment eliminates this bottleneck.

Many industries and markets are increasingly requiring much greater flexibility and timeliness from their manufacturers. The need to manufacture small quantities of highly customized products with perfect quality and hundred percent on-time delivery, and at a low cost is forcing companies to abandon the old techniques of mass production. To compete in this changing and unpredictable marketplace, and to thrive upon it, companies are integrating agile manufacturing methods in their manufacturing systems. These methods require highly integrated and flexible technologies of production; not necessarily high-tech methods, but highly capable. To adequately address their customer's fast changing and focussed needs, the company's people must be very highly educated and trained, and significantly empowered within the constraints of a clear vision and delineated company principles and goals. The company itself must have the ability to effect change rapidly, have highly flexible management structures, and comprehensive methods of introducing change and prospering from it. There must also be a mechanism for readily creating informal alliances with other companies and organisations—even competitors—to design and produce products and service that address the needs of customers and the emerging marketplace. These changes are taking place very fast in some industries, and more slowly in others. But the companies that will meet the challenges of the ever-changing global marketplace of the twenty-first century are those that are able to become agile in every aspect of their business. Agility is not a "magic wand" to solve all ills. It is built upon the firm foundation of world class

To manufacture small quantities of highly customized products with perfect quality and hundred percent on-time delivery at a low cost. Companies are integrating agile manufacturing methods in their systems.

manufacturing methods, coupled with an organisation that is physically, technologically, and managerially established for rapid and unpredictable change.

Benchmarking

Benchmarking is the search for industry best practices that lead to superior performance. Benchmarking has been defined as "a continuous, systematic process for comparing performances of organisations, functions or processes against the "best in the world", aiming to not only match those performance levels, but to exceed them" (Camp, 1989 and 1995). According to Dr. Carla O'Dell, President, American Productivity & Quality Centre (APQC), benchmarking is "the process of identifying, understanding, and adapting outstanding practices and processes from organisations anywhere in the world to help the organisation improve its performance." Benchmarking allows us to analyse and improve key business processes, eliminate waste, improve performance, profitability and market share. Benchmarking's strength is that it allows decisions to be made based on facts, not intuition. The benchmarking process is of significant potential benefit to industry when used as a continuous process, as an identifier of areas for potential change and also as a measurement process to monitor improvements achieved (Carla O'Dell, 1994).

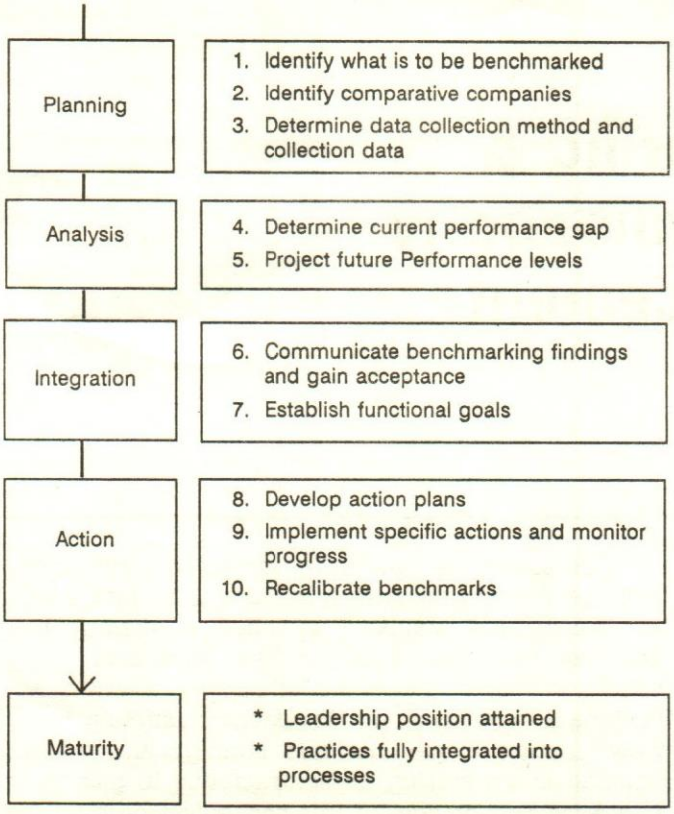
Benchmarking's strength is that it allows decisions to be made based on facts, not intuition.

Practices and processes range from customer service to human resources, from warehousing and distribution to leadership. Even industry-specific processes, such as claims processing in insurance, are candidates for learning from any organisation that processes "orders" rapidly, including mail order houses and banks. Benchmarking is not only competitive analysis or "number crunching," nor is it spying, espionage, or stealing. It is truly a process of organisational learning. Benchmarking offers the opportunity for breakthrough improvements—not 5 per cent or 7 per cent, but gains of 30 to 50 per cent, sometimes even 300 or 500 per cent! Firms that are already behind are going to need such breakthrough gains to catch up, then continuous improvement to stay ahead. Speed is critical, if for no other reason than to overcome the enormous inertia of the status quo. As Jack Welch at GE has said, "Incremental change doesn't work very well in the type of transformation GE has gone through. If your change isn't big enough, or revolutionary enough, the bureaucracy can beat you" (Carla O'Dell, 1994).

Origin

For practical purposes, benchmarking came on the scene in the early 1980s. At this time, Rank Xerox faced nearly a fifty per cent reduction in their market share. It was discovered that unit manufacturing costs were the same as its competitor's selling price. They realized that something dramatic had to be done to turn the trends around. Rank Xerox began, in their manufacturing operations, a process of competitive benchmarking, by which they selectively analysed competitor's products, their operating capabilities, and quality. This was expanded to not only concentrate on meeting a competitor's achievements, but to identify the means for creating processes and methods that would allow Xerox to achieve market superiority. By 1989, Rank Xerox had won the coveted Malcolm Baldrige National Quality Award, and had regained the majority of its market share losses. Rank Xerox, and other successful benchmarking organisations, realised that it was not merely copying the most successful methods or practices that would result in success, but that they had to fully understand their own company before they could apply any insight they may obtain of the fundamental technical, process and cultural characteristics that allowed the best in class to be the best. Understanding yourself, understanding how the "best" do what they do, and adapting it to your organisation realities, are the keys to achieving success. Benchmarking is one of the fundamental ways of achieving that goal. By 1984, at Rank Xerox, a corporate wide benchmarking network had been formed and since 1990 benchmarking has been totally integrated at all levels. Robert C. Camp, the father of benchmarking has the largest individual contribution in benchmarking exercises at Rank Xerox. The use of Benchmarking grew rapidly throughout US since late 1980s. Benchmarking became a recognised tool in the development of a continuous improvement process. Indeed the prestigious American prize for quality, the Malcolm Baldridge award, has incorporated benchmarking into its guidelines. In India, benchmarking is a relatively unapplied technique. It has made a beginning in a small way in some of the Indian companies (Pandit & Khanna, 1999).

Understanding yourself, understanding how the "best" do what they do, and adapting it to your organisation realities, are the keys to achieving success.



[1] Adapted from Camp (1989)

Fig. 2. The benchmarking process at Rank Xerox[1]

The benchmarking process followed by Xerox, being also the most popular model worldwide, is summarised in Fig. 2.

Steps in Implementation

Before a benchmarking initiative is undertaken, a sponsor of the process is established. This person must be sufficiently senior within the organisation to pilot the process through and to support the findings. Benchmarking team is established and proper training is imparted to the team so that the team completely understands the benchmarking process before start of the study.

Planning phase comprises three steps which are: identifying what is to be bench marked, identification of best marketing partners and data collection. In the Analysis phase, current performance "gap" is determined and future performance level is projected. During the Integration phase, the benchmarking findings are communicated and acceptance gained. The functional goals are established at this stage. Action phase comprises three steps which are: to develop action plans, to implement specific actions & monitor progress and finally to recalibrate benchmarks. At the Maturity phase, leadership position is attained and practices are fully integrated into the processes.

Effective Benchmarking is an ever increasing management prerequisite to implementing meaningful positive change. It is not the latest management fad. Benchmarking has been around since the early 1980's and is widely practiced across the USA, and has been growing rapidly in Europe, Australia and Asia. The Malcolm Baldridge National Quality Award has, directly or indirectly, earmarked approximately 680 points, out of a maximum of 1000 points, to Benchmarking activities. In India there is not much evidence of concerted efforts by the firms to take advantage of Benchmarking. There is also need for conceptual clarity amongst the managers. Training programs, seminars and other such forums can provide opportunity for bringing managers together for appreciating and sharing information on vital aspects of benchmarking.

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Focus

World Class Manufacturing & Benchmarking – The Philosophy of Performance Enhancement

Suresh Chand Aggarwal

The key to long-term success is being able to do certain things better than your competitors can. One of the most powerful techniques for gaining and maintaining this competitive advantage is 'benchmarking'. It is a standard of business excellence, against which others can measure and compare their performance. Once the measurement hurdles are overcome, the organisation can strive not only to achieve the 'standard' and close the gap but also to surpass it and improve its performance everyday. But to achieve full benefits of benchmarking, the firms must adopt a rational and rigorous framework. Only then world class manufacturing goals, itself a moving target could be realized.

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Companies are now being forced to continuously improve their manufacturing operations as they aspire to 'World-Class' status. They need a strategy that specifies the kind of competitive advantage being sought in market place and articulates how that advantage is to be achieved. Manufacturing strategy today must support overall business strategy and indeed, companies are looking to manufacturing to give them competitive advantage e.g., the best quality product, the lowest product cost, the shortest lead-time and the best customer service.

World Class Manufacturing

World-class manufacturing is a way of achieving this competitive advantage from manufacturing. It is the pursuit of superior performance through continuous improvement using principles such as just in time manufacturing (JIT), total quality management (TQM) and employee involvement, not to mention lean manufacturing, reengineering, bench marking and the team approach. While some of these improvement efforts have been successful, the majority has not been. But even those companies where the efforts have been successful may have attained just the status of their toughest competitors and lament that they are not ahead. A true manufacturing strategy, therefore, is a plan for developing

World-class manufacturing is the pursuit of superior performance through continuous improvement, developing skills and capabilities to do certain things better than competitors over the long haul.

skills and capabilities that will enable a company to do certain things better than competitors over the long haul. In this endeavour, the past decade has witnessed a rebirth in manufacturing, as companies worldwide have responded to rapidly changing consumer tastes and technologies as well as intensified global competition by pursuing 'World-Class' productivity, quality and flexibility as strategic imperatives.

Looking at manufacturing strategy is the key to long-term success. Such superior organisation capabilities provide a lasting advantage than one based on something the organisation can build or buy. The organisation may be able to buy access to a certain technology, for example, but cannot buy the ability to use it efficiently, sell it effectively, or advance it over time. Manufacturing strategy aims and focuses on getting better at the things necessary to defend its attained position. However, in a turbulent environment, being world class is not enough; a company also has to have the capability to change gears—from, for example, rapid product development to low cost—relatively quickly and with minimal resources. The job of manufacturing is to provide that capacity and capability.

As competition continues to stiffen, strategies that focus on costs will evolve naturally into strategies based on quality and subsequently on customer satisfaction. Indeed, this is already happening at many leading companies, e.g. L&T, Amtrex, Crompton Greaves, Citi Bank, etc. Attention to customer satisfaction, which measures the quality of customer service, is a logical next step in the development of quality measures. However, the perpetual goal of these companies is to achieve measurably better performance than the rivals. One of the most powerful techniques for gaining and maintaining competitive advantage is 'benchmarking'.

What is Benchmarking

Benchmarking involves identifying competitors and/or companies in other industries that exemplify 'best' practice in some activity, function or process and then comparing one's own performance to theirs. These results are used as a basis for comparison to provide targets for performance. The benchmarking exercise, therefore, means you,

- analyze the position you are currently in
- find someone who is measurably doing better, and
- learn from them what they are doing to achieve that performance
- then adapt your practices and processes as a result of that learning and implement relevant changes which will effect superior performance in your organisation.

Benchmarking involves identifying competitors that exemplify 'best' practice and comparing one's own performance to theirs.

Benchmarking is an active exercise and leads to positive actions being taken. It enables to close the gap between how the company is currently performing and how much better it could be doing. The distance between these two points is established through comparison with the better performers, while closing the gap is achieved through the changes or adaptations the company makes to its process as a result of the lessons learned from the benchmark company. The continuation of the process enables the company to develop the best practices for the organisation. This externally oriented approach makes people aware of improvements that are orders of magnitude beyond what they would have thought possible. In contrast, internal yardsticks that measure current performance in relation to prior period results or the results of other units within the company may bring only slight improvement. It could nonetheless, simultaneously bring complacency through a false sense of security among these benchmarked units and an unhealthy trend of intra unit rivalry instead of craving for competition in the market place. Benchmarking could bring benefits to an organisation only if systematic and rigorous 'benchmarking' comparison and analysis of performance data is carried out.

Internal yardsticks that measure current performance in relation to prior period results or the results of other units within the company could bring complacency and an unhealthy trend of intra unit rivalry.

Since nineties, many national and international quality standards, like ISO 9001, 9002, etc. and awards have been instituted as different countries face the challenge of stimulating manufacturing and service base to become more competitive in the face of global competition. These standards provide visible, public 'excellence' goals for organisations to aim for, as well as assessment criteria against which to measure and

monitor activity. The assessment criteria however, require more than the immediate performance: trends, levels and comparisons need to have been monitored over a period of time – usually three years. The organisation must show whether and how they have used the comparative information to help them adapt their processes and practices in order to achieve measurable improvements in their own performance, results and customer satisfaction levels. So in the context of corporate performance, the 'benchmark' is a standard of business excellence against which others can measure and compare their performance.

New Measurement Perspective

The decision about what to measure is one of the initial hurdles managers must cross when benchmarking. In the past, financial performance has been the mainstay of the success of a business firm and targets were set for the future on that basis. Generally capital asset turnover, net return on direct assets or investment, and profit per unit of output activities were selected as performance measurement. But in a changing environment, it became difficult to identify potential failure points or sources of problems as they occurred. Realization has dawned on executives of industries that financial performance by itself does not gauge the health of a business and represents only one perspective, among many, on the emerging scorecard of measures. New strategies and competitive realities demand new measurement systems. Market share, customer satisfaction, quality of products, speed of response and service and quality of working life become important in determining strategy, promotions, bonuses and other rewards and are relied as measures of success.

Today organisations aspire for World class performance and strive to improve daily. Continuous improvement must be aligned with the long term strategy and objectives of the business. No organisation can afford to utilize resources without regard for its overall health and development. The focus is on identification and measurement of critical success factors, which enable the organisation to meet strategic objectives. In defining measures, management must decide what the key indicators of performance are, how they relate to one another and how they can be used to track the short, medium and long-term health of the business. For instance, having identified 'quality' as a strategic weapon, many firms have introduced defect rates, reject rates, response and delivery time as key measures. So, the role of benchmarking as a tool to increase competitiveness is extensive. It not only helps firms compare themselves on their existing measures with the current 'benchmark' performers, it also enables the development of new strategic measures against which to monitor performance. The continuous process would give opportunities for improvement that are orders of magnitude unthinkable otherwise. Hence, benchmarking is transforming managerial mind-sets and perspectives.

Benchmarking Framework

The ability to replace incremental improvement with major leaps forward is the essence of benchmarking's power. However, to gain full benefit, the firms must adopt a rational and rigorous framework. A typical benchmarking process that has been adopted by many organisations involves: Planning, Analysis, Action and Review Stages.

Planning Stage

Select the subject area: It is important that not everything is benchmarked; otherwise it can create lot of confusion. The organisation should focus efforts where improvements will bring significant advantage to the business. Focusing on one single process brings the best results. A cost benefit analysis about benchmarking can be undertaken. So deciding the broad direction is important before actual benchmarking starts.

Define the process: Once the area is decided (for example, innovation, customer service, financial management), the next step is to identify and define the processes. It involves – defining the boundaries of process; agreeing on step sequence, i.e., the first and last steps of the process; and mapping it.

Identify potential partners: Benchmarking is essentially identifying the best practices and development based on catching up with it. The best practice could exist within or outside an organisation. One need not stop with the competitors in the industry but should also look beyond their own industries so as even to surpass competitors. Cadbury, Hindustan Lever, American Express Travel, Gabriel, etc. did the same. So product benchmarking may be done with a direct competitor but for process benchmarking, it makes more sense to look across industries.

Benchmarking is essentially identifying best practices. One need look beyond own industries for process benchmarking.

Identify data sources and select appropriate collection method: The objective of this step is to identify and plan where to find data on the organisations that emerge from the brainstorming of the previous step. The infor-

mation may be coming either with mutual cooperation between two or more benchmarks or it may be out in the form of balance sheets, trade journals, market survey findings, media coverage and other databases available with consultancies.

The Analysis Stage

Collect data and select partners: Once the data is collected and analysed to eliminate the unsuitable firms at the previous stage, a short list is now prepared of most likely potential partners who are performing better at whichever process is the subject of improvement efforts.

Determine the gap compared to benchmark: At this stage the objective is to establish the magnitude of difference.

Establish process differences: The organisation now tries to establish the reasons or practices behind the performance gap. What do the better performing organisation do and why? Many of the answers could be found in the culture and traditions of these firms. However, the cultural differences may be too great and there may be insufficient commitment in the organisation to effect the degree of change required to introduce or support the best practice. Alternatively, it may be that the time and cost required to make the change are greater than originally envisaged, planned or budgeted for.

Target future performance: Once the size and nature of the gap in performance is known to an organisation, it should be able to devise targets that are realistic.

The Action Stage

Communicate to management and other: Benchmarking would involve introducing and managing change. The affected employees may resist some of these changes. Therefore, clear, effective and convincing communication about changes and consent of people is essential for success.

Adjust goal and develop improvement plan: In view of the feedback from the communication, it may become necessary to make some adjustments in the original targets. These should be made and incorporated in the final improvement project implementation plan.

Implement: In view of some resistance, implementation may not always be easy. Although there are no magic formulae for successful implementation, unfailing attention to detail and rigorous follow-through are the essentials.

Review

Review progress and calibrate: Once the implementation plan has been followed through, the entire team should get together to review progress against objectives. Sometimes it may take several repetitions of the benchmarking process before the ultimate 'best' state is achieved. This is normal and far better than falling into the trap of sacrificing success to 'completion at all cost'.

Benefits & Challenges

Once the benchmarking process is successfully implemented, it is expected to extend certain benefits to the organisation and to the individuals. Some of these are: improved performance and profitability; improved quality of working life; increased efficiency of operations; opening doors to other organisations; etc. But senior level commitment is important for initiating and implementing projects, which advances the organisation's strategic objectives.

Benefits are improved performance and profitability, improved quality of working life, increased efficiency of operations.

Perhaps the biggest test for benchmarking today is the fact that World-class-performance is a moving target. CEOs who set eyes on improvement by comparing themselves with the best—even if it is themselves—in every process must, therefore, institutionalize benchmarking within the organisations so that their managers can, of their own initiative, seek out the best practices constantly and close the gap continuously. Corporates do that in different ways and reap the benefits of world class manufacturing, e.g., better quality, shorter production lead times, reduced cost, higher volume, reduced inventories, reduced employee turnover and absenteeism, reduced machine breakdowns, high employee morale, higher sales, higher profits, better safety, on-time delivery, etc. But in today's world, nothing is predictable and unfamiliar competitors emerge from unexpected directions at the worst possible time. A company should therefore, think of itself as a collection of evolving capabilities, not just as a collection of products and businesses, which provide the flexibility needed to embark in new directions. Gaining competitive advantage from manufacturing has taken the shape of a revolution that seems to be never ending. It is a new philosophy of performance enhancement that is an ongoing, evolving process.

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Quality Initiatives in a Manufacturing Unit: A Case Study

Ayoob Ahmed Wali, S.G. Deshmukh & A.D. Gupta

In the present context of globalization of economy, Indian organisations face challenges, which did not exist before when there was not much emphasis on quality of products, systems, and procedures. After the liberalization process, customer focus has become imperative for the very survival of any organisation. The paper is based on a case study carried out to explore quality initiatives in one of the leading manufacturing organisations in India producing products used in agri-processing. The present work consists of a survey done on the company ratings against critical success factors for TQM and company practices of various principles and techniques of quality management.

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Manufacturing sector is significant in a developing economy such as India. It contributes 30 per cent of GDP (Gross Domestic Product), [Source: Survey by Tata Economics Services, 1999] and is one of the largest employers. In recent years it has become responsive to market needs driven by competitive pressures. In today's environment, quality is the key to an organisation's success and survival. However, quality improvement cannot be achieved without significant process changes. By focusing on long-term goals and objectives, an organisation is better able to compete; provide quality product and services; develop a positive corporate image; respond in a timely manner to changes in the marketplace; and control costs, resulting in a production system which reduces wastes, reworks and scraps (Huq & Justin, 1998).

Production and operations management literature identifies quality as a core content variable having strategic significance for the operations of a firm (Kanji et al, 1992). More importantly, profitability is partially quality driven. The relationship between quality improvement and profitability has been explained clearly by Garvin (1987).

There are many definitions of quality. Each definition has its own group of supporters. Some typical definitions of quality include:

- Conformance to requirements (Crosby, 1979)
- Degree of uniformity and dependability at a low

Definitions of quality include: Conformance to requirements, Degree of uniformity and dependability, Product performance which results in customer satisfaction.

cost with quality suited to the market (Deming, 1986)

- Product performance which results in customer satisfaction (Juran & Gryna, 1995).

Garvin (1984) has analyzed various quality definitions, and classified them into five categories:

- Transcendental: excellence, the highest standard.
- Product-based: dependent on the attributes.
- User-based: satisfying the want of a customer, fitness for use.
- Manufacturing-based: conformance to requirements.
- Value-based: value for money.

Garvin (1987) has also listed eight important quality dimensions: Performance, features, reliability, conformance, durability, serviceability, aesthetics, and perceived quality.

Organisation Profile

A case study was done to assess quality initiatives of a leading organisation engaged in manufacturing of agro-processing machinery. The company XYZ Ltd. is a BT (Business Today) 1000 company with an annual turnover of Rs. 1272 crores in 1998-1999. The break up of the engineering changes initiated by the company in each of the past five decades is as follows:

1944-1954 (Creation): The launch of the Company as an agency house in 1944. The Company also set-up its first industrial venture in equity collaboration with Germany.

1955-1964 (Automation): The company goes public: A full-fledged manufacturing orientation takes place with commencement of company's own brand of tractors. The company joins hand with another company to produce India's most advanced pistons required for automobile sector.

1965-1974 (Consolidation): Manufacturing of tractors was started in the 70's with the collaboration of a USA based company Employees Ancillary Ltd., a unique venture in industry democracy comes into being.

1975-1984 (Diversification): With an alliance with JCB for India's first Excavator traders for railway tracks with Japanese collaboration. XYZ become the country's largest Motor Cycle Manufacturing company. Acknowledged leadership in automotive ancillaries' pistons and Goetze rings.

1985-1994 (Globalization): XYZ Ltd. enters into joint venture with buy back arrangement with a company for Harvester combines in USA and another company in hydraulic valves providing an entry into world market.

1995 on-ward (Challenges and Competitiveness): Journey towards the quality system ISO 9000, from 1994 to 1998, where XYZ got ISO 9001 certificate in January 1998 from the certification body of TUV Management Service GmbH – Germany: for design, development, production, marketing and internal finance. Also XYZ is on the way to getting ISO 14000, for their effort to protect the environment.

The following summarises the philosophy of the company:

The company's works will be profitable, efficient, and environmentally aware. The company would aim for being an innovative leader in the national and international market with the aim of providing all customers, internal and external, with quality products and services, and ongoing continuous improvement process, keeping in mind the vision, which is to build a strong and unified industry that would not only withstand all difficulties but also fulfill its responsibilities to the society and nation at large.

The company profile is summarized in Table 1.

Table 1: Profile of XYZ Ltd.

Location	North India
Product Range	Tractor, Piston rings, Automotive Shock observer
Annual Turnover	1272 crores
No. of Plants	10 plants
No. of Employees	2500
No. of people in quality dept.	120
Production rate	12000 units per year
% Rejection rate	= 1.24

History of Quality Management

The quality journey was initiated as soon as XYZ started manufacturing process, realizing that producing good quality products free from defects, and providing reliable after sale services is the only way of doing the business and satisfying the customer. From 1994 the journey for ISO 9000 certification was started which moved on till the year 1998 when the company became

an ISO 9001 company, for applying Quality System for design, development, production, marketing and internal finance.

The success of quality programme and ISO 9001 certification were due to the manufacturing facilities being modernized in accordance with global norms. The company has made substantial investments in R&D to incorporate state-of-the-art technology in the manufacture of new models. It has also introduced Business Process Reengineering via TQM for product and process upgradation.

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The quality policy of the company, states,

"We shall strive to continuously improve to meet the ever rising expectations of our customers at the lowest possible cost.

Each one of us must fulfill the needs of our customers, both Internal and External, with the highest degree of commitment, thereby creating a Quality organisation geared to ensure total customer satisfaction and sustained health and prosperity of our business".

The clarity of quality policy and support from the top management have helped in wider acceptance of quality concepts amongst employees. The key to improving quality is to improve processes that define, produce and support the products.

All people work on following principles:

- Get processes "in control"
- Work with other employees and managers to identify process problems and eliminate them

Managers and/or Supervisors work on processes by:

- Providing training and resources to employees.
- Measuring and reviewing process performance (metrics): A number of indicators are employed
- Improving process performance with the help of those who use the process. This is done by:
- Defining the process
- Measuring process performance (metrics)
- Reviewing process performance
- Identifying process shortcomings
- Analyzing process problems
- Making process change
- Measuring the effects of the process change
- Communicating both ways between supervisors and users

Performance Metrics: The organisation is oriented towards customer satisfaction in terms of providing high quality products, at reasonable price, delivery on time, and providing after sales training and services. Innovations in new projects are highly encouraged. Financial metrics plays an important role in success of any organisation. The company's profit has improved from Rs. 71 crores to Rs. 167 crores in just three years representing a 135 per cent improvement. The company achieved a profit of over 10 per cent on sales with only 60 per cent improvement in turnover. Reserves have grown from Rs. 182 crores to Rs. 731 crores during this period.

Quality Improvement Teams: To increase quality process, statistical process control (SPC) teams were formed. These teams were cross-functional. In 1996 the concept of quality circles was introduced whose main focus was on process improvement with the help of quality management principles.

Quality Tools: The company practices several types of simple quality control (QC) tools, such as control charts, cause-effect diagram, histograms etc. Operators are trained to use tools. For easy acceptability and understanding, simple instructions are given in Hindi.

Reward System: The company has different types of reward systems based on the company policy to encourage the staff for improvement and innovation in their jobs. The incentives are in terms of recognition and monetary benefits. Some of them are: Suggestion schemes award, Housekeeping award, Best safety award and Best Employee of the year award.

Experience and advantages with ISO 9000

- Systems and procedures are documented and being followed
- Paint quality improved
- Reduction in rejection, rework, machine breakdown

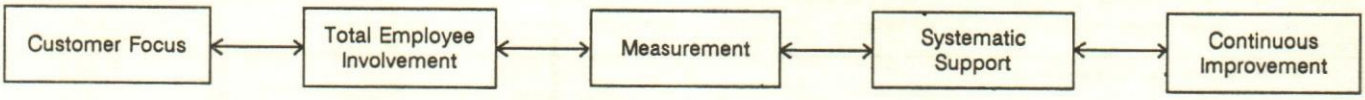

Fig. 1. Quality Pillars and Quality Strategy

- Reduction in rejection from vendors
- Improvement in straight pass ratio
- Response time to customer complaints reduced
- Improvement in spare parts availability to customers
- Faster action on design change request and design changes
- Better internal and external customer satisfaction as reflected in low employee turnover, improved morale, less number of complaints from customers, operators etc.

Other Quality Concepts: Sessions on TQM awareness and related concepts are held every three months for the managers, staff, and workers through various training programs. So there is a high degree of awareness of concepts such as, Quality Circle (QC), SPC, TPM, BPR, IT, and Kaizen which play an important role in continuous improvement process.

In brief the quality strategy and pillars which are followed by the company can be represented as in Fig. 1.

Methodology

Field visits to the unit were organized in conducting the case study. Fourteen persons from different sections and departments, with different specialization and work experience participated and filled in a structured questionnaire and this was followed by interviews and information discussion.

The objectives of the questionnaire were to assess:

- How the participants rate their organisation's current degree of practice in Quality management against each factor.
- Important performance indicators (how frequently they measure it and how they rank them)
- Practice of quality management principles, tools and techniques.

Fig. 2 gives an overview of the methodology adopted.

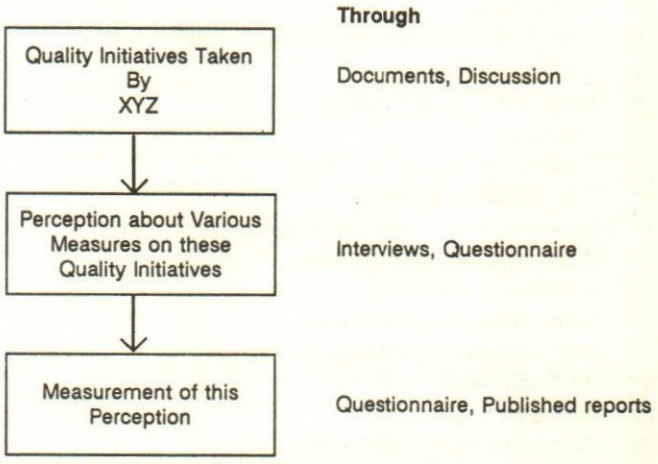

Fig. 2. Methodology Adopted

The questionnaire had three parts: First part included basic information about the organisation (demographic variables), Second part listed 69 items on different types of quality related elements on a five-point interval scale which were grouped into 23 headings, and Third part included statements about the performance system. This questionnaire was pre-tested based on feedback from academia and industry.

Discussion & Results

Table 2 gives the descriptive analysis of 23 factors, wherefrom columns 2 and 3 show the mean value and standard deviation in decreasing order of the mean value, the first seven values having mean value equal or greater than 4.00, while the remaining factors have a mean value between 3.00 and 4.00, and only factor 23 has mean value of 2.96. Coefficient alpha in column 4 shows the Reliability (Internal consistency) measure for the factors. Nunnally (1967) suggests that reliability coefficient of 0.6 is sufficient. The values of alpha in each case indicate, therefore, that each factor is a sufficiently reliable measure. Only factors 15 and 18 show values less than 0.6, however this does not mean that these two factors are not reliable. The small values are due to the small number of participants in comparison to the number of factors. Column 5 gives KMO value for sampling adequacy. KMO values of 0.7s - 0.8s range are considered 'meritorious' those in the 0.6 - 0.7 range being 'middling' (Kim & Mueller, 1978). It should be noted that KMOs of 0.5 are rather poor, although not

Table 2: Mean and Standard Deviation for Critical Factors for XYZ

Factors	No. of Items (N)	Mean*	Std. Dev.	α	KMO value
1. Personal/unit performance perception	3	4.270	.115	.889	.513
2. Future enterprise vision	3	4.237	.117	.781	.537
3. Process measurement/qualification	2	4.175	.050	.778	.500
4. Process benchmarking/quality auditing	2	4.105	.050	.982	.500
5. Quality policy	3	4.027	.231	.891	.629
6. Peer performance perception/system stability result	3	4.023	.146	.851	.523
7. Quality task resources	3	4.000	.185	.688	.649
8. Awareness of quality strategy	4	3.965	.135	.820	.579
9. Innovation	2	3.857	.202	.962	.500
10. Customer satisfaction sensitivity	4	3.823	.331	.800	.621
11. Quality process alignment	2	3.820	.255	.690	.500
12. Supervisor's supportive role in quality improvement	5	3.760	.377	.702	.499
13. Quality involvement of leaders	4	3.731	.137	.947	.862
14. Social/moral maturity	2	3.640	.099	.614	.500
15. System feedback coordination	3	3.629	.410	.505	.494
16. Communication/information sharing	3	3.593	.146	.847	.679
17. Work unit delight	3	3.567	.145	.886	.726
18. Ethical work culture	3	3.500	.140	.515	.504
19. Organisational health/work stress	2	3.460	.354	.722	.500
20. Quality rewards/recognition	5	3.416	.225	.866	.630
21. Attitude/Morale	4	3.375	.386	.806	.604
22. Total quality ecological sustainability	4	3.360	.297	.829	.500
23. Peer team support	2	2.960	1.061	.609	.500

(*) on scale (1 to 5)

α = Cronbach's alpha value (Nunnally, 1967)

KMO = Kaiser-Moyer-Olkin Measure (Kim & Mueller, 1978)

Table 3: Quality Initiative Undertaken by XYZ

Initiatives	Measures	Percentage of respondents using the measure
Use of team processes	• Number of team activities	21.4%
	• Perceived effectiveness of team processes	35.7%
	• Outcomes of team activities	71.4%
Focus on internal customers	• Awareness about internal customers among staff	57.1%
	• Perception of internal customers about quality service	64.3%
Common understanding of quality as satisfying the needs of external customer	• Awareness of concept	28.6%
	• Ability to express customer needs	92.9%
Understanding of customer needs	• Ability to express customer needs in decisions in terms of internal activities and measurements	78.6%
Ability to meet customer needs	• Improvements in customer satisfaction measures	92.9%
Emphasis on use of data and understanding variation in decision-making	• Extent of training in use of data	21.4%
	• Extent of application of data analysis	35.7%
	• Understanding of the impact of variation on decision-making	64.3%
Understanding of organisational processes	• Documentation of processes	21.4%
	• Awareness and understanding of documentation	85.7%
	• Knowledge of undocumented features of processes	14.3%
Understanding techniques of improvement, and ability to improve	• Training and application of techniques of improvement	42.9%
	• Understanding of how techniques can be applied to major processes with the aim of improvement in customer satisfaction	57.1%
	• Evidence of improvement	64.3%
Ability to reduce variability of products and services to provide greater reliability	• Evidence of reduced variation and increased reliability	78.6%
Ability to reduce waste	• Evidence of reduction in waste	92.9%

Table 4: Effect of Quality Initiative

	Before	After
Rejection Rate (%)	4-5%	1.24%
Profit (Rs. Crores)	71 Crores	197 Crores
Reserves (Rs. Crores)	182 Crores	731 Crores
Net Sales & Business Income (Rs. Crores)	1105.6	1295.8
Manufacturing expenses (Rs. Crores)	231.3	279.2
Customer Satisfaction (No. of complaints)	7	3
(Delivery Response Time)	1 month	15 days to 20 days
Man Hrs Lost	560	50
Safety (Injured persons)	4	Zero

Table 5: Performance indicators, used by XYZ

Performance Measures	Indicators	Total Score	Ranking	Quarterly	Monthly	Weekly	Daily
Financial Performance	• Inventory margins			x			
	• Product turnover				x		
	• Revenue	118	I	x			
	• Expenses				x		
	• ROI, NPV, IRR						x
	• Gain in market share				x		
Customer Satisfaction	• Lead time					x	
	• Quality	113	II		x		
	• Delivery time				x		
Operation Performance/ Manufacturing	• Quantity of work						x
	• Quality of work						x
	• Flexibility	113	II				x
	• Receptivity						x
	• Dependability						x
	• Work attitude				x		
Productivity	• People productivity						x
	• Material productivity	94	III				x
	• Machine and equipment productivity					x	
Innovation/ Technology	• Emerging technology			x			
	• Cycle time (product introduction, research & development)	89	IV	x			
Human Resource	• Employee morale				x		
	• Turnover	73	V		x		
	• Commitment				x		
Impact on Society	• Safety of the environment			x	x		
	• Safety of worker						x
	• Response to Culture change	65	VI	x			
	• Economic advantage			x			
	• Improvement towards quality of work life			x			

Ranking is computed based on total score where

Total Score = $\Sigma Ri \times wi$; Ri = 1 to 10 Where R1 to R10 are the ranking order from the highest (1) to the lowest (10) and w = weight given to the metric on a scale of 1 to 10 (10 for the highest and 1 for lowest important).

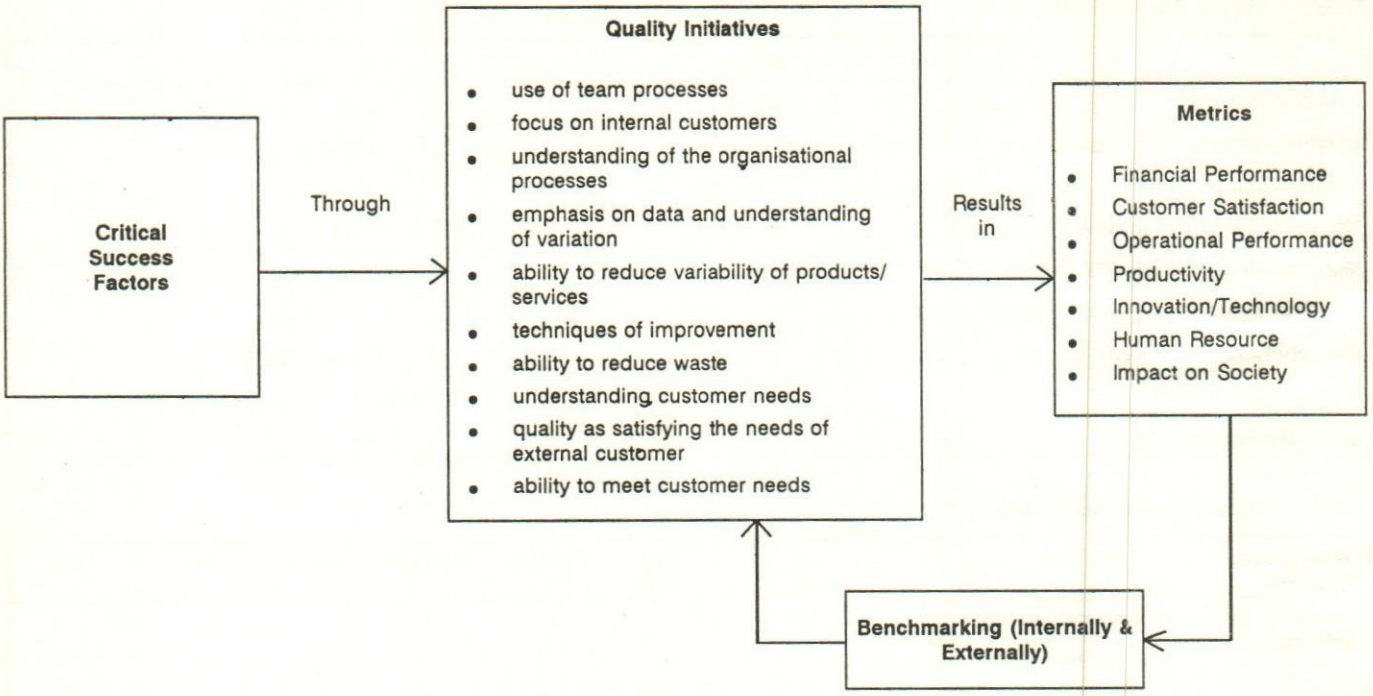

Fig. 3. TQM Model

unacceptable, this is because the number of factors is more than the number of cases.

Kaiser-Moyer-Olkin Measure (KMO value) is used for testing the construct validity of the factors. (KMO is a measure of sampling adequacy, and it is used to measure the adequacy of the sample for the extraction of factors).

The quality initiatives to be taken by the organisation, were evolved after a series of brain storming sessions. These measures are given in Table 3. As a result of these, the performance of XYZ improved in several dimensions. This is evident from Table. 4. The TQM model (Fig. 3) pre supposes that there is some system for performance measurement in place in the organisation. A prioritized list of such measures is given in Table 5. The system amply captures the performance on a variety of dimensions (both financial as well as non-financial). As expected, the financial measure is most important for this manufacturing organisation. This is followed by customer satisfaction and operational performance. Interestingly, productivity is at the third position. The way these measures are actually computed is given in Table 5. This table also indicates the modal frequency associated with each measure.

Conclusion

Imperatives for quality initiatives are to maintain/sustain competitive edge, streamline processes and cut down costs. Ability to meet customer needs, understanding of the organisational processes and ability to reduce waste have been considered most important in their quality improvement journey. The quality journey in the organisation under study began with a clear statement and quality policy and support from top management. The employees were involved through small improvement teams and quality circles. As a result of these initiatives, the financial performance of the company as well as customer satisfaction have improved.

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JIT Elements in Indian Context: An Analysis

Vikas Kumar & Dixit Garg

JIT is a production methodology which aims at improving overall productivity through elimination of waste of all kinds. Difficulties in implementation of JIT are due to "work culture" of country and available production facilities. Therefore, JIT implementation problems of industries of developing countries may be different from these of developed countries due to lack of technology, low productivity, inferior quality and faulty criteria of decision making etc. This paper takes a closer look on JIT implementation problems and benefits in Indian context.

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Improvement in productivity is the aspiration of any industry. To achieve this, effective and economical techniques are required. A number of productivity improvement techniques are prevalent in industries. But special attention should be given towards JIT (Just In Time) manufacturing system that has great potential to perform well in Indian context. JIT is not a technique or set of techniques of manufacturing, but is an advanced approach or philosophy which embraces both new and old techniques and provides a wide range of benefits by renovation of existing manufacturing system. A more simple definition of JIT is "an approach that ensures that right quantity is purchased at right time and there is no waste" (Voss, 1990). Waste is found in our conventional approaches to design, purchasing, job assignment, plant configuration, equipment selection, maintenance, scheduling, accounting, product line development, material handling, material control, shop flow control etc. JIT improves productivity through elimination of waste of all kinds.

It can be seen that no one technique can stand alone. JIT production is also a combined effort of some subtechniques like cellular manufacturing, kanban system, group technology, set up time reduction etc. Cellular manufacturing is based on Group technology. In cellular arrangement, cells are formed to produce a family of parts of similar design and/or manufacturing. A family of parts for a cell is determined by group technology on the basis of their 'sameness'. The cells are linked to each other through an ordering and delivering system called 'kanban'. High flexibility, proper division of work and responsibilities, effective inventory control are main characteristics of these subtechniques. In short, JIT manufacturing system entails the combination of some techniques in area of manufacturing, production control and purchasing which have common goals of high productivity, high flexibility and perfect quality at low cost, based on the principles of elimination of waste of all kinds and continuous improvement.

Need of JIT in Indian Context

Developing countries like India, Brazil etc. are restructuring their economy to face competition in global market and to increase the level of privatisation. Consequently, Indian Industries have been pushed from protected market environment to uncertain and competitive global market environment while they are plagued by shortage of resources, lack of advanced technology as they are still using traditional manufacturing systems like product layout, process layout, continuous process etc. The price for adaptation of these traditional manufacturing system is paid in the form of long work in process, large in process inventories, lost orders and poor quality. Thus the opening of Indian economy poses new challenges and opportunities for Indian Industries because high competition and market globalization greatly affect profit margins.

Most Indian Industries were practicing 'mass production strategy' earlier. But this strategy is not practicable in the present globalised environment because three basic conditions must exist for feasibility of mass production strategy. These are Less variety of products, Large order quantity and Long product life cycle. Now large variety of products are available in market, causing less order quantity. On the other hand, product life cycle become shorter because products cannot draw customer attention for a long time period due to continuous improvement in design of product, technology advancement and individual taste of customer. Such environment makes it difficult to forecast the exact demand of a particular product. The most effective and economical solution of this problem is adoption of 'stockless production strategy'. This strategy works as a mechanism to manage demand in form of uncertain orders and provides good results, when product varieties are increasing and product life cycles are becoming shorter. But 'stockless production' is only possible in JIT environment . It is, therefore essential to implement JIT techniques to rescue the Indian Industries from precarious conditions. In short, JIT has emerged as a productivity improvement tool for the manufacturing sector in the context of recent reforms of Indian economy.

JIT has emerged as a productivity improvement tool for the manufacturing sector in the context of recent reforms of Indian economy.

Survey of Indian Industries

JIT philosophy originated and developed in Japan where advance production system and quality management have deep roots due to unique working environment, availability of multifunctional workers, high level of literacy and high level of automation. In such conditions, implementation of JIT elements is comparatively easier than in India. Some questions related to JIT have great significance in Indian context. These are:

- What are the essential elements of JIT and related benefits?
- Which are the JIT elements difficult/easy to implement in Indian context?
- Which are the most expected benefits, playing major role in Indian context to set the profit margin?

Methodology

A survey of Indian Industries was conducted on the basis of available list of JIT elements and related benefits which were identified by Garg and Deshmukh (1999).

The main objectives of the survey were to identify:

- those JIT elements which are highly difficult to implement;
- those which are easy to implement in Indian context, and
- to identify the most expected JIT benefits in Indian context.

A questionnaire was prepared and mailed to 50 different companies including Swaraj Mazda, Ropar; Atlas Cycle, Sonepat; Parle Biscuits, Bahadurgarh; Mark auto, Gurgaon; HMT, Pinjore; Haryana sheet, Sonepat; High-Tech gear, Bhiwadi; Hero Honda Motors, Dharuhera etc. Majority of the surveyed companies were around Delhi and Chandigarh for logistic reasons. In all, twenty two responses (response rate = 44 per cent) were received.

Table 1: General profile of Companies

Types of company	Automobile (4) Heavy machines Textile (2) other (11)
Annual turnover (in crores)	Maximum (2500) minimum (1) average (158)
Number of employees	Maximum (6000) minimum (25) average (938)
Percentage of scrap	Maximum (10%) minimum (2%) average (6%)
Percentage of rework	Maximum (15%) minimum (4%) average (8%)

General profile of surveyed companies is given in Table 1. The surveyed companies represent automobile, heavy machinery, textile, chemical, electronics and other industries. The average number of employees was 938. Among surveyed companies, average sale volume is 158 crores. The maximum percentage of scrap observed is 10 per cent while average percentage is 6 per cent. Average percentage of rework is 8 per cent.

Analysis

Collected data was analysed with the help of factor analysis on scale (0-100) in Tables 2-5. Table 2 represents the list of essential elements of JIT and their aggregate scores obtained after factor analysis. Table 3 displays the degree of difficulties in decreasing order. It is found that some unique JIT elements like quality circle, layout improvement, long term contract, small lot size, continuous improvement, effective communication, high quality, smooth flow of material, buffer stock removal, statistical process control, smooth production, work in process reduction, work center quality control, statistical quality control, total quality control are easy to implement while other elements like Zero defect, automation and autonomation, zero deviation schedule, kanban system, cellular manufacturing, preventive maintenance, product and process simplification, process flexibility, computer integrated manufacturing, setup reduction time are difficult to implement. In general, the survey made it clear that it is slightly difficult to implement JIT elements in Indian context.

Surveyed companies have been attempting to realise a wide range of JIT benefits. The attainment of

Table 2: Degree of Difficulty in JIT Elements Implementation

Elements	Very difficult	Difficult	Little difficult	Easy	Very easy	Aggregate score
Automation & Autonomation	8	8	6	0	0	77.2
Buffer stock removal	1	3	3	9	6	35.2
Cellular manufacturing	8	8	4	2	0	75.0
Computer integrated manufacturing	1	13	8	0	0	67.04
Continuous improvement	0	4	4	5	9	28.4
Effective communication	1	2	4	8	5	29.5
Flexible workforce	2	4	9	5	2	43.0
Long term contract	1	1	3	8	9	23.8
High quality	0	4	4	6	8	29.5
JIT purchasing	7	7	5	3	0	70.4
Layout improvement	0	1	4	9	0	22.7
Kanban System	8	7	7	0	0	76.1
Long term employment	2	4	10	4	2	50.0
Preventive maintenance	4	3	8	7	0	57.9
Process flexibility	5	5	9	3	0	63.6
Product & process simplification	2	6	10	4	0	56.8
Quality circles	0	4	2	3	13	21.5
Set up time reduction	6	8	4	4	0	68.1
Small lot size	0	3	3	8	8	26.1
Smooth flow of material	1	3	4	5	9	32.9
Smooth Production	0	5	5	5	7	37.5
Standardization	2	6	7	5	2	51.1
Statistical process control	3	2	4	6	7	36.3
Statistical quality control	3	3	4	7	5	40.9
Total quality control	2	3	7	6	4	42.0
Work centered quality control	2	3	7	3	5	38.6
Work in process reduction	1	5	4	6	6	37.5
Zero defect	9	7	6	0	0	85.2
Zero deviation schedule	8	7	7	0	0	76.1

Table 3: Degree of Difficulty in JIT Elements Implementation

(In decreasing order)

Elements	Agg. Score
Zero defect	85.2
Automation and autonomation	77.2
Zero deviation schedule	76.1
Kanban system	76.1
Cellular manufacturing	75.0
JIT purchasing	70.4
Set up reduction time	68.1
Computer Integrated manufacturing	67.04
Process Flexibility	63.6
Product and process simplification	56.8
Preventive maintenance	57.9
Standardisation	51.1
Long term employment	50.0
Flexibility workspace	43.0
Total quality control	42.0
Statistical quality control	40.9
Work centered quality control	38.6
Work in process reduction	37.5
Smooth production	37.5
Statistical process control	36.3
Buffer stock removal	35.2
Smooth flow of material	32.9
High quality	29.5
Effective communication	29.5
Continuous improvement	28.4
Small lot size	26.1
Long term contract	23.8
Layout improvement	22.7
Quality circle	21.5

full benefits depends upon successfully implementation of JIT elements. Table 4 expounds the JIT benefits and their aggregate scores, which are obtained after factor analysis on scale (0-100). Table 5 represents degree of expected benefits in decreasing order. It is found that improved competitive position, improved worker efficiency, increased flexibility, increased quality, increased productivity, reduced inventories, reduced production lead time, reduced purchase lot size, reduced work in process, increased equipment utilisation, less scrap, reduced paper work, increased profit margin, reduced raw material requirement, increased equipment efficiency, increased team work are highly expected benefits whereas other benefits like increased administrative efficiency, lower overheads, reduced labour cost, improved worker motivation, reduced space requirement occupy lower priority. In general, surveyed companies have reported high degree of expected benefits driven from JIT implementation.

Discussion

JIT manufacturing system has been widely discussed and well received all over the world. Despite the worldwide attention, JIT is not fully understood and the implications of implementing JIT in developing countries have not been adequately appreciated (Chandra & Kodali, 1997). Some researchers have identified that few elements are not deep rooted in India due to following obstructions:

- Set up reduction is a principle component of JIT. It saves wastage of time and money. Innovative ideas and persistent research are required for this. But India is leading among those developing countries which have least research and development facilities (Korgoanker, 1992).
- JIT puts emphasis on ordering small lots. In India, ordering cost counts a lot due to present tedious system of ordering which involves lot of paper work. It is therefore considered better to place a big order to take advantage of quantity discount. But, Gupta et al, (1995) represents a model which can provide quantity discount in JIT purchasing.
- The concept of preventive maintenance at present is possible only in big houses as small houses do not want to spend money on regular maintenance. They are interested in taking maximum possible work from a machine and go for repair only when breakdown occurs (Korgoanker, 1992).
- JIT requires total co-ordination between various components of an industrial network. Proper and reliable transportation facilities are required for this which are poor in India (Garg D., 1997).
- TQC (total quality control) is an essential element of JIT. But, it is being ignored. Consumer ignorance may be considered as the prime factor for this. Protective market attitude and earlier government policies of non-liberalization were also key factors in non-implementation of TQC which is indispensable for JIT (Ansari, 1986).
- There is a great need for employee involvement. But, working conditions create lower worker

Table 4: Degree of Expected Benefits

JIT benefit	Very high	High	Average	Little	Not at all	Aggregate score
Improved competitive position	10	8	3	1	–	80.6
Improved equipment efficiency	6	9	6	1	–	72.7
Improved worker efficiency	7	8	6	3	–	76.1
Improved worker motivation	3	5	4	6	4	46.5
Increased Admn. efficiency	2	4	10	4	2	50.0
Increased equipment Utilisation	5	8	6	3	–	67.0
Increased flexibility	11	5	3	3	–	77.2
Increased Inventory turnover	7	9	5	1	–	75.0
Increased profit margin	6	8	6	2	–	70.4
Increased quality	9	8	4	1	–	78.4
Increased productivity	10	6	5	1	–	78.4
Increased team work	12	4	2	2	2	75.0
Less scrap	7	9	3	3	–	69.3
Lower overheads	4	6	6	6	–	59.0
Reduced inventories	10	7	5	–	–	80.6
Reduced labour requirement	4	5	9	4	–	60.2
Reduced paper work	7	6	7	1	1	69.3
Reduced product cost	3	4	10	5	–	55.6
Reduced production lead time	12	7	3	–	–	85.2
Reduced purchase lot size	14	5	2	1	–	86.3
Reduced raw material/parts	6	8	6	2	–	70.4
Reduced space requirement	4	7	9	2	–	64.7
Reduced work in process	15	4	3	–	–	88.6

morale. Thus, employees are not motivated enough to join the movement voluntarily (Garg D. 1997).

- The greatest attribute of JIT which makes it suitable for Indian industries is that most of its elements do not require much investment. JIT predisposes the way in which manufacturing functions are being performed using existing facilities. It also requires some change in methods of purchasing and marketing. Difficulties in implementing JIT can overcome by bringing a change in attitude of people through training programs.

Concluding remarks

Based on the study, some important conclusions are as follows:

- In the era of liberalization and privatisation, Indian industries need instant support of a meaningful and effective manufacturing system like JIT to follow the trend of globalisation in order to become more competitive.
- Prefect JIT implementation may not be feasible in most Indian industries due to lack of resources, lack of technology, non availability of multi-

Table 5: Degree of Expected Benefits (In decreasing order)

JIT Benefits	Agg./Score
Reduced work in progress	88.6
Reduced purchase lot size	86.3
Reduced production lead time	85.2
Improved competitive position	80.6
Reduced inventories	80.6
Increased quality	78.4
Increased productivity	78.4
Increased flexibility	77.2
Improved worker efficiency	76.1
Increased inventory turnover	75.0
Increased team work	75.0
Improved equipment efficiency	72.7
Reduced raw material/parts	70.4
Increased profit margin	70.4
Reduced paper work	69.3
Less scrap	69.3
Increased equipment utilisation	67.0
Reduced space requirement	64.7
Reduced labour requirement	60.2
Lower overheads	59.0
Reduced product cost	55.6
Increased administrative efficiency	50.0
Improved worker motivation	46.5

functional workers etc. However, some elements are easy to implement as reported by Indian Industries. Therefore, maximum weightage must be given to these elements to reap maximum benefits.

- Co-relation of Table 2 (Degree of difficulty in implementation of JIT elements) with Table 4 (Degree of expected benefits) made clear that some elements like cellular manufacturing, kanban system etc. are difficult to implement in Indian context. But, these elements provide a wide range of benefits like reduction in WIP, reduction in inventories, increased flexibility etc. after successfully implementation.
- Innovative ideas and persistent research work are required to solve the problems of JIT implementation in Indian context.
- The survey presents a macro view of the state of JIT elements and related benefits in Indian Industries. It is, therefore, necessary to carry out such studies in groups of same types of industries based on ISO-9000 Certification, product being produced and size to get better results.
- In general it is strongly recommended that Indian Industries must implement JIT, may be in phased manner. This will certainly make them more competitive.

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MANAGEMENT THOUGHTS : BY PRAMOD BATRA

Your mind is like an acre of land

Your mind is like an acre of land. You have to care for it like a farmer does for better results. You have to sow it (with ideas), till it (with readings), fertilize it (with visits to counterparts), pesticide it (to prevent it from becoming inanimate) to get the best crop of results from it.

□ Think Inc., Batra

Using IT for Competitive Advantage: A Supply Chain Perspective

M.L. Singla

Computers-Communications Technology is an all pervasive organisational phenomenon in the contemporary business environment. Seeds of this technology, which were sown in the Indian economic soil about 10 years back have nurtured into full trees. The question of "What we can do with IT" is likely to assume greater significance as compared to "What IT can do for us". Innovation in use of this technology will be the most pertinent issue in management of IT. The author takes stock of the impediments in the exploitation of IT and suggests some measures to combat these limitations. He also evaluates how IT can be leveraged for Supply Chain Management towards gaining competitive advantage and highlights the role of emerging technologies such as Geographical Information Systems.

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An Indian Information Technology (IT) start-up walked away with a $ 3 million contract within months of its take off for creating complex products to enable companies to transform into e-corporations by integrating their processes like supply chain management, customer relationship management and enterprise resource planning in the legacy systems (Times of India, 2000). First Cyber*Bad*, now Cyber*Delhi*, with Delhi deciding to commission a few thousand infokiosks and cyber *dhabas*, this could well be the beginning of emergence of an e-society. The victory of Andhra Pradesh based TDP both in the Parliament and State Assembly elections is having a bandwagon effect on the political bigwigs. Cyber*Rath* is being considered the most potent political vehicle today. Experts claim to have renovated just e-verything–from *e*-mail, to *e*-banking, to *e*-communities, to *e*-commerce, to *e*-auctions, to *e*-woman, etc. In other words, IT is redefining the way societies are constructed, function, and grow all over the world. Investments made by economies as a percentage of their GDPs are on the increase. Many developing countries including India, have viewed this field worth giving special status to enable infrastructural development.

IT is redefining the way societies are constructed, function, and grow all over the world.

IT Revolution: Origin & Scope

Success stories like Dell Computers and Hewlett-Packard which have leveraged their supply chains using IT based solutions are a plenty by now. Giant organisations which offer great potential of performance improvement are making an all-out attempt to become *e*-savvy, while facing related problems. State Bank of India is moving towards the statutory requirement of 70

per cent computerization much ahead of the target date dictated by Central Vigilance Commission. The competition is not behind. Punjab National Bank, another premier institution, went in for an organisational transformation exercise to be followed by supportive IT implementation. Oil & Natural Gas Corporation initiated an Organisational Transformation Project followed by major IT initiatives. Hindustan Lever transformed to an IT-enabled supply chain so as to bring down the overall turn around time from 45 days to 20 days which led to better customer response. The Crack Tech Team at ICICI is busy wiring up the organisation through a computer-n-cable network, a historical achievement in Indian financial sector. And all others are following suit. Indian Airlines which was in the advance stages of growth on Nolan's Stage Hypothesis way back in 1990, is leveraging its systems like Passenger Support System extended into the Frequent Flier System providing connectivity to over 1000 travel agents and airlines all over the world. Maruti Udyog, the Rs. 8008 crore auto major of India, implemented data warehousing in 1998 with more than 40 per cent of its supply coming in through bar coded process at present. Mahindra & Mahindra trained 1700 employees for implementing the 'most dramatic and aggressive transformation' in recent times.

Seeds of technology which were sown in the Indian economic soil about 10 years back have nurtured into a fully blown jungle, but it still remains a jungle. Whereas inter-functional, inter-departmental and inter-organisational supply chains are being harnessed, the bigger question which remains to be addressed is whether our corporates are ready to become e-corporates. The third party involvement for facilitating settlements and handling delivery shipments is still in infancy state. While Electronic Data Interchange, Electronic Fund Transfer, Smart Cards, Interactive Multimedia, Data warehousing, Satellite and Wireless Communications, as well as Electronic Shelf-edge Labeling are evolving rather fast on the Indian business horizon, the deployment of these technologies at the district, state and national level are still a far fetched dream. Geographical Information System technology could fuse into the available technologies for providing cyber connectivity.

While Electronic Data Interchange, Interactive Multimedia, Satellite and Wireless Communications are evolving rather fast on the Indian business horizon, the deployment of these technologies at the district, state and national level is still a far fetched dream.

There is a paradigm shift in thinking IT and expectations experiences, and expertise in the management of IT have been witnessing a phenomenal change. IT which was historically viewed as an exponential additive to unemployment and corporate costs, all of a sudden is being treated as a panacea for all corporate, economic, social and development disorders. Success in the emerging electronic marketspace will largely depend upon an appropriate exploitation of IT in managing relationships with suppliers, in managing customer relationships, in being innovative, in harnessing ongoing battles with rivals by changing the basis of competition (Porter & Millar, 1985). In the contemporary world, where technology is providing a level playing field to all, regardless of size, experience, location and resource base, "What we can do with IT" will assume greater significance as compared to "What IT can do for us". Innovative use of available technologies will be the most significant factor in successful exploitation of IT.

IT which was historically viewed as an exponential additive to unemployment and corporate costs, is being treated as a panacea for all corporate, economic, social and development disorders.

Computers-Communications Technology is an all pervasive organisational phenomenon in the contemporary business environment. Every new technology promises to deliver better efficiency and effectiveness in organisations. But the fact remains that with installation of latest hardware and software system, the dissonance commences immediately on signing the acceptance certificate. Is it the oversell of marketers, or our inability to exploit the installed technology? While experts march on talking about the INTERNET, INTRANET, EXTRANET, ERP, and e-World, corporate users feel more lost as compared to their counterparts of yesteryears. There is no denying that this technology is capable of acting as a transformational agent in lives. It offers unlimited potential for leveraging competitive edge, this potential remaining to be harnessed in most of the cases. The emerging scenarios of Internet based businesses and telecommunications based transaction processing systems will lead to cutting down of not only the perceptual size of the globe, but also the size of the organisational costs to design, create, and market products and services. There are going to be strategic opportunities which will be encashed only when we are using the fastest emerging weapon of IT. Organisational information is not innocent and managing information strategically will also mean managing it shrewdly. But as on date, organisations suffer from a common malaise—IT

is still being viewed as at best a tool to bring about cost competitiveness, when applied strategically (Cash, et al, 1985). Some of the recent managerial innovations such as Total Quality Management, Just-in-time, Process Re-engineering and Enterprise Resource Planning (ERP) lean heavily on use of IT.

The fact remains that with installation of latest hardware and software system, the dissonance commences immediately.

Traditionally, it has been believed that Decision Support Systems could provide the competitive edge. But today, any of the Computer Based Information Systems (CBIS) components such as Office Automation Systems, Transaction Processing Systems, Management Information Systems, Decision Support Systems, Management Support Systems, Executive Information Systems(EIS) or Expert Systems (Kroeber & Watson, 1984) could be used to leverage competitive edge. There could be instances where, by including competitors' products, we may gain an edge over the industry. Porter's Five Force Model (Porter, 1980) and the Value Chain Analysis (Porter, 1985) can be used as complementing high potential analytical frameworks for identifying areas for strategic use of IT. A bank's 24 hour customer enquiry service could be considered a good example of Office Automation System being used as a competitive weapon. Total branch mechanization currently being pursued by many of the nationalized banks of India could be considered an answer to the IT supported onslaught by foreign banks.

Potential of IT

During the last thirty years or so, economists and management theorists have been forced to expand traditional production and statistical models to include the impact of information and IT on the performance of these models. As a result of systematic increase in IT and information, there has been a noticeable improvement in productivity, quality, and customer service (Cash et al, 1992). The IT resource has travelled from DP Era (1960-1975), to the Network Era (starting 1995 and likely to go upto 2010). Despite the fact that most of the companies have moved from the DP Era to the Network Era, yet the resource of IT has not been fully harnessed. The issues of design, management, and global exploitation need to be adequately addressed. This alone will become an increasingly critical factor in determining the competitive strength of these businesses. The "network" structure characterized by point-to-point electronic communication, teams, and strategic alliances is more appropriate for harnessing information technology in contemporary environment. A fifth generation technology like *e*-Commerce can not be implemented in a second generation organisation using hierarchical structures (Savage, 1990).

The issues of design, management, and global exploitation need to be adequately addressed.

As per a study conducted by HBS Colloquium on Global Competition and Telecommunications (Nolan & Seger, 1993), there will be a major shift in thinking IT. The emerging IT based solutions will be marked by the "new" fusion of Information Technology and telecommunications; the new technology will be extremely dynamic and will change the fundamental structure of the firms to networked firms; competitive strategies of the firms will be greatly affected by the above two as well as the resultant new industries. IT will have a tendency to restructure industries over the entire supply chain. This restructuring will necessarily mean different ways of competing, co-operating, and collaborating among buyers, sellers, and rivals. Entry and mobility barriers in many cases will be demolished by the use of IT and fresh barriers will get erected in many industries. The new technology, as it can be seen, will not only bring about better efficiency levels while carrying out traditional activities, but will also act as an enabler for fundamentally changing the basis of competition among rivals within the same industry segment. The next generation organisations will have smaller span of control in the traditional sense and larger span of control in the fifth generation sense. This widening of span of control will be facilitated by the innovative use of IT.

Emerging IT based solutions will be marked by the "new" fusion of Information Technology and telecommunications.

The realization of potential offered by IT is catching up fast in the Indian industry too. If a state electricity board can start thinking in terms of reducing the losses or increasing the profits just by using technology aiming to bring down the average billing and collection cycle or control power theft by better accounting in a division; an

insurance company can think of increasing its profitability by reducing the crediting cycle from 15 days to 3 days by use of technology; and an organisation can think of reducing inventory levels from Rs. 1400 crores to Rs. 1000 crores without affecting the business; IT does provide an excellent tool for improving the competitive position of an organisation. These are only some variations at the process level and do not involve the enduser. In these examples, the business is not changed, the customer has not been affected and we have also not touched suppliers and still we have been able to bring in business advantages. There are many more opportunities, where we can add significant value by using IT and pass on part of the advantage to the customers too. In other worlds, IT can become an effective driver, facilitator and coordinator of business processes.

IT can become an effective driver, facilitator and coordinator of business processes.

Creating business vision today will need an awareness of the availability and capabilities of IT. Demand forecast for a product like automobile tyres could be entirely misleading when we consider the onslaught of emerging technologies such as tele-commuting, tele-banking, e-cash, tele-shopping and other forms of e-business. A seed germinating and marketing company can really become a market leader and sustain its competitive position, if it resorts to development of a simple expert system to be installed at the retailer site. A business forecaster can not afford to overlook such possibilities in the times to come. A helicopter view of traffic administration in a congested metropolitan city like Delhi can help us design an integrated system for better Traffic Management as well as Accident Control at a much lower cost.

In public administration, IT can play a pivotal role facilitating better levels of service. In a country like India where file movement in public administration becomes very important for determining efficiency, process and step benchmarking assumes a critical significance. And this can not be successfully implemented without having IT based solutions. There are offices where IT based file tracking systems have been designed and successfully implemented. Step benchmarking would also be able to pinpoint individual responsibility and further help in streamlining the systems. But all these advantages can not be attained until we create an IT vision for business or administrative set up. As per a survey, the CEOs were found to be unanimous in their belief that IT was critical to the success of their firms.

In public administration, IT can play a pivotal role facilitating better levels of service.

A survey of 96 respondents from various sectors highlighted that the organisations viewed Internet as a technology that can not be ignored; that will serve as a strategic tool; and that will add to the competitive advantage vis-a-vis their competitors. Respondents from retail & wholesale, financial services, and computers & communications reported to be leading in Internet based implementations. Some of the results have been documented in Table 1. The table shows that as we move from simple e-mail to complex e-commerce, the percent organisations in respective sectors using any advanced technology starts climbing down.

Another survey of 107 executives indicated that almost 60 per cent of the population accesses the Net everyday, most of them preferring to do so during late night hours. Nearly 50 per cent of the population surfs the Net for less than 5 hours a week, no doubt there were respondents who were spending 10-25 hours per week on net surfing alone. 35 per cent of the respondents indicated that they had Net connectivity both at office as well as home. Majority of the users used Net for transacting e-mail and downloading professional information. They usually hit upon new sites through word-of-mouth.

Table 1: Usage of Internet Based Technologies

Sector	%ge Res	E-Mail	Internet-Mail	WWW access	Web site	EDI	E-Commerce
Manufacturing & Distribution	35	79	64	29	50	54	21
Computers & Communications	17.5	100	86	100	71	71	57
Financial Services	20	100	88	88	88	75	25
Retail & Wholesale	2.5	100	100	100	100	0	100
Others	25	89	78	67	67	33	11

The above figures are based on a very small sample size but are certainly indicative.

Impediments

Some of the impediments in the exploitation of IT in a developing country like India would normally include the following:

Generation Gap: Charles M. Savage (1990) had suggested the existence of a generation gap between the organisations and deployed technologies. Indian corporates suffer from this phenomenon. Second generation organisations continue procuring, deploying, and under-utilizing these expensive fifth generation technologies without realizing the gap.

The IT Leadership Crisis: IT Management has been perceived to be sole responsibility of CEO and his team in Indian organisations, whereas IT leadership is a convergence of efforts of the Strategic Management, the IT Team, and the Line Management.

Benchmarking and Learning Organisations: Indian organisations continue to exist in isolation without benchmarking their processes against the best practices and learning while operating. Non-learning organisations can never become the best-in-class.

Non-professional Polity: In India, ownership and decision making for majority of infrastructural systems rests with the government, bureaucracy and polity. Unless these cadres are trained to appreciate and innovatively use IT, benefits will not be forthcoming.

Infrastructural Inadequacy: India Inc. suffers from a phenomenal infrastructural inadequacy as a result of which none of inter-regional, inter-state and inter-national initiatives can be implemented. The e-efforts continue to be restricted to base camps alone.

The Mindset: What is needed to be re-engineered is the national mindset to bring about a conviction about the capabilities of IT. The major focus of mindset re-engineering has to be infusion of spirit of competitiveness and accountability in the sectors which determine the character of the economy.

Measures for Successful IT Implementation

To ensure that organisations use IT smartly and we build IT smart organisations, some of the precautions which will be needed to be taken would include:

Not aping: Aping someone else will not help. Newer innovative applications and associated architectures will determine the winning teams.

CEOs being good CTOs: IT leadership is the key to successful implementation of IT based solutions. To make India Inc. an Internet enabled society, strong IT leadership among the polity is a must. All initiatives have to be commissioned from the top and that too with conviction.

Creating Sustainable Architecture: For India Inc. to become a major global player on the Net, an appropriate IT architecture will need to be created.

Appropriate Cyber legislation: For e-biz to take off in the country, the government will have to develop suitable cyber laws for the purpose of accounting and taxation.

Designing complementing Physical Delivery Systems: To ensure that Indian population develops confidence in e-biz, the corporates and utilities will be required to work towards development of performing delivery systems so that the post-delivery dissonance is minimized. Whereas the content information on e-malls is going to replace physical display; on screen context is going to replace face-to-fact auction; and IT infrastructure is going to replace the physical sites—physical delivery of services and goods is going to assume greater significance.

Harnessing GIS Technology: Unlike Singapore Tradenet, the Indian NII is going to be a mammoth job and without an appropriate use of Geographical Information Systems(GIS), developing an NII for India will be a Herculean task. GIS is likely to make the physical geography of the country irrelevant.

Redefining Virtual Boundaries: The planners will be required to consider the map of India as a continuum of the entire globe. The boundary will be virtual boundary facilitating international transactions and free flow of information, content, matter, and people.

Believing in Core Competency: Leave the job to the man who does it best. Outsourcing of the IT function by corporates, states, countries will be the in thing.

Global Vision & Niche Focus: We have come full circle. The trade started with paying attention to an individual customer during the barter era, and we are back to focussing on an individual customer. Mass customization is the trick of the day. Only now we communicate in an impersonal manner through electronic medium.

CBIS & Emerging Paradigms

Information Systems can be differentiated from data processing from the user's point of view. Traditionally, Electronic Data Processing was the first sub-system to be used in business organisations. It is recently that data processing is being treated as comparatively a lower level activity as compared to other information systems. Data processing is basically aimed at process-

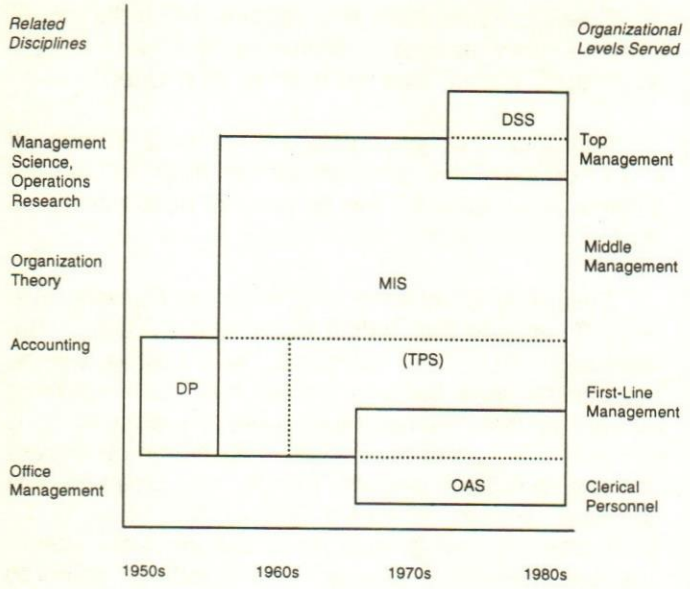

Fig. 1. CBIS – A Contingency View

ing of transactions generated from day-to-day operations within an organisation whereas other types of information systems are designed for supplying information from the processed data to various levels of management to provide support to individual and group executive decision making. Collectively, these systems are termed as Computer Based Information Systems (CBIS) (Kroeber & Watson, 1984). A contingency view of this classification framework is shown as in Fig. 1. Summary observations on this classification would include:

Information Systems can be differentiated from data processing from the user's point of view.

- Transaction Processing Systems(TPS) are always the first systems to evolve in an organisation. The technology, experience and expectations from these systems are already well established. These form the hub of an IS activity in an organisation.
- Office Automation Systems(OAS) are activities and processes which assist office personnel in performing office routines and do not lead to generation of any business data directly.
- Management Information Systems (MIS) are designed to support the decision making activity of key executives in an organisation. These systems make use of the already processed transaction data and some external inputs.
- Decision Support Systems (DSS) make use of the summarised organisational data as well as external data collected from the environment of the organisation and are leveraged for assisting top management in taking unstructured as well as semi-structured decisions having long term impact.

The class of information systems which is creating waves on the corporate horizon is Executive Information Systems (EIS) which by definition are meant for executives in American terminology, i.e. the top two layers of management to support strategic decision making. They provide drilling down through successive layers of data bases in the shortest possible time span necessarily based on Graphic User Interface (GUI) technology. EIS makes use of graphical and data mining techniques. Geographical Information Systems provide wide support to EIS. In other words, EIS is a full derivative of different forms of CBIS. It makes use of data management techniques of TPS, communication techniques of OAS, reporting techniques of MIS and modeling techniques of DSS. When we add an additional capability of GUI, this leads to an EIS.

Different types of CBIS necessitate different technologies. Table 2 sums up the technologies which are needed for implementation of different types of CBIS.

Supply Chain Management

"Just give me the right product at the lowest cost, on time – thank you" is what lies underneath the typical confrontation relationship in a supply chain system, whereas an ideal full blown supply chain partnership will be based on process/capability-based buying relationship. Though Electronic Data Interchange (EDI) has historically been used for the purpose of maintaining control over the inbound and outbound movement of materials, it is now that corporates have started talking in terms of reduced time, reduced costs, and mass customization. EDI has the potential of helping organisations increase market share, minimize working capital requirement, get world-class service performance from

Electronic Data Interchange has the potential of helping organisations increase market share, minimize working capital requirement, get world-class service performance from suppliers.

Table 2: Status of CBIS

Type of CBIS	Technology Needs	Technology Status In India
Transaction Processing Systems	• Hardware • Software • Database Technology • Networks • Electronic Data Interchange	Fairly Stable
Office Automation Systems	• Communications (Internet based technologies) • User friendly equipment • Integrated Suites • Compatibility with traditional systems • GUI based systems	Exploding
Management Information Systems	• Communications • Data Base Management • Analytical Tools	Quite Stable
Decision Support Systems	• Interactive Interface • Complex Modeling • Data Pipelining • Complex Infrastructure	Evolving
Executive Information Systems	• Enterprise Resource Planning • Data Warehousing • Data Mining • Information Superhighways	Nascent Stages

suppliers, improve warehouse and facilities utilization, and reduce re-ordering. It is in this regard that management of supply chain assumes critical significance.

EDI properly harnessed will bring about the benefits of more accurate and timely information flow; administrative savings, closer trading relationships, improved cash flows, moving closer to the end consumer (Gattorna & Walters, 1996). On the manufacturers' side, EDI can help in increasing the market share, improved cash flows, attaining zero out-of-stock situations, and smooth long term relationships with all partners. Organizations that are likely to benefit from EDI initiatives would be characterized by features such as multiple locations, high turnover of inventory, large volumes of recurring transactions, need for accurate reporting and tracking, and a need for timely processing.

The supply chain has been viewed as the sequence of suppliers and organisational buyers that spans all stages of processing from raw materials to final customers. It involves the external factors, i.e. those sources of goods and services that are not under direct corporate control, and internal product transformation activities, i.e. those facilities and services which are under direct control of the corporate. Supply chain management emphasizes the basic issue of identifying those product transformation activities which could possibly be done best by outsiders at a lower cost, with a better level of dexterity, and in shorter time span. Supply chain would necessarily include understanding the stream of material flow from suppliers' suppliers, through the suppliers (both internal and external), through the manufacturer, through our customer (internal or external), and upto the customers' customers. A company would normally be concerned about the sourcing strategy, the demand flow strategy, and the customer service strategy as part of supply chain management. The shift in thinking in supply chain management would be from outsourcing (a confrontational relationship) to an outpartnering (a fully blown relationship) based on the inter-organisational systems considering all the suppliers and all the buyers as boundary less virtual organisations.

Supply Chain Management & IT

Supply chain management which once centered on the distribution of products to customers, has now assumed a broader perspective of full flow of logistics with strategic and financial importance within the organisations (Macbeth, 1995). Instead of looking at only the cost consideration, the emphasis has shifted to harnessing the function to make it a tool for gaining competitive advantage. Porter's Five Force (Porter & Millar, 1985) Framework for competitive analysis outlines the areas how IT could be leveraged to gain competitive advantage in an industry. The supply chain decisions which enable end-to-end optimization throughout can be made with the help of modern intelligence and decision support tools (Seethamraju, 2000).

Supply chain management has assumed a broader perspective of full flow of logistics with strategic and financial importance within the organisations.

For managing supply chain in an organisation, what we need to look at is whether IT can help in:

- Building flexibility in operations
- Planning and measuring accurately
- Decomposing Processes (developing logistically separate operations wherever appropriate)

- Getting lean by simplicity and speed
- Optimizing information
- Segmenting & Stratifying (treating customers unequally)
- Operating globally without additional costs
- Practicing Virtuality and collaboration
- Exploiting E-Commerce and cutting down the transaction cost
- Leveraging People (making better use of human capital)
- Conceiving & Destroying (operationalizing new products and phasing out old ones)
- Mass Customization and postponing part of the process to the customer's vicinity

If answers to some of these are affirmative, IT is certain to add value and the organisation should move over to supply chain solutions like INTERNET (INTRANETS, and EXTRANETS), ERP and others. In case most answers are negative, then the organisation better be happy with "brick-n-mortar" solutions.

Concluding Remarks

With materials accounting for more than two thirds of the value chain, harnessing IT for managing supply chain would be the 'mantra' for survival, growth and economic significance of a business. Time-to-market and cost-to-market will be the factors which determine the potency of a new product idea. Most importantly, solutions like Enterprise Resource Planning need to be extended over the entire supply chain and confinement of these implementations to a single enterprise may not necessarily facilitate integration amongst the partners in the supply chain. In times to come, Geographical Information Systems would become the backbone of supply chain management for corporates having wide spread presence.

Solutions like Enterprise Resource Planning need to be extended over the entire supply chain.

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Six Sigma – Paradigm Shift in Management's Quality Strategy

P.R. Lakshmi Kantan

When the customers are more quality conscious – the Concept of Cost of Quality emerged and thus Statistical Quality Control came into existence. Six Sigma is a concept which starts and ends with the customer. In six-sigma approach, the fundamental reasons for problems are fathomed so that pin-pointed corrective actions can be initiated. Six Sigma Concept has become a business quality strategy in successful companies.

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Conventional Quality Control is based on inspection oriented approach. Items are produced according to the specifications of the customer and are segregated using inspection methods. First grade items are sent to important customers and second and third grade items to less important customers. The cost of inspection – a nonvalue adding activity – is not considered as it is added to the product price. In a seller's market this is acceptable.

When the customers became more knowledgeable the Concept of Cost of Quality emerged and Statistical Quality Control came into existence. The maxim of this concept is prevention is better than cure; statistical modelling techniques are used to predict the behavioural pattern. Due to advent of ISO 9000, Quality Control has become broad based i.e. from product orientation to process orientation and there is a new concept of statistical process control. In this approach quality is brought into different processes in a business such as manufacturing, purchase, marketing, sales, human relations etc. Though all these approaches in spirit aim for greater customer satisfaction, customer focus is missing. Six Sigma is a concept which primarily starts and ends with the customer.

What is Six Sigma?

All business houses are saddled with problems and solving a problem requires resources in terms of man power, machine, material, money etc. Mostly, problems are looked into at a stage when drastic remedial actions are the only available solution. This approach leads to frustration, time and money losses. Besides, there is no

In Six Sigma approach, the fundamental reasons for problems are fathomed so that pinpointed corrective actions can be initiated.

guarantee that solutions are going to be permanent. In Six Sigma approach, the fundamental reasons for such problems are fathomed so that pinpointed corrective actions can be initiated. Hence the focus is on problem origin.

The basic philosophy is that problem arises because of variation in systems. For example a bulb fuses because line voltage fluctuates beyond 260 volt (as long as the voltage is within 230 volt ± 20 volt, there is no problem). Ironically in a living system, variation is a must. Variation is necessary but too much of variation is detrimental. The entire concept of Six Sigma revolves around variation; the term depicted for variation is Sigma. The permissible variation is a concept determined by the customer. For example a customer may demand ±1 micron accuracy on diameter whereas another one may want ±1 over 2 micron accuracy! A business can not run its operations according to each customer's requirements. They should organise the processes such that they can satisfy all customers.

Why Problems Crop Up?

Three types of reasons generate a problem: (a) Actions are initiated when no action is required; (b) Actions are not initiated when action is required; (c) Actions are initiated but not at the opportune time. The following are the examples:

(a) Body temperature is OK but using a faulty thermometer readings are taken and found to be 101°C. Immediately medication starts.

(b) An operator makes a mistake in reading a drawing but the mistake is overlooked. Components are made.

(c) Euro II norms are introduced in certain types of cars when already competitors have taken an edge on this.

In all these cases, variation increases and hence the birth of a problem which leads to increased cost and customer dissatisfaction.

Role of Statistics in Six Sigma

Anticipation of a problem is the fulcrum of modern business strategy. If one can anticipate a problem, its sources, and develop a prevention action package, he has arrived at a permanent solution. Statistics is a Science of data and data is the voice of the process and its problems. Using data extensively, anticipatory models are developed so that decision makers are equipped with the right type of decision making approach. Since decision making is a management concept, Six Sigma Concept has become a business quality strategy in successful companies. General Electric Company of USA has successfully adopted this technique developed by Motorola to great success.

Anticipation of a problem is the fulcrum of modern business strategy.

Board room matrices are indices of performance of a company as seen by top management. Some of the important board room matrices are:

OTD → order to delivery i.e. cycle time

OTR → order to receivables – shorter the better

No. of turns: For Inventory hold ups, larger the number of turns, better the performance (similar to just in time inventory).

Dash board: The salient indicators of a company's growth similar to the car dash board displaying fuel, speed, distance etc.

Structure of Six Sigma Training Programme

The programmes are designed in four phases:

Phase 1 : Define and Measure

Phase 2 : Analyse

Phase 3 : Improve

Phase 4 : Control

Subsequently Phase 3 and Phase 4 are merged. Phase 1 deals with defining a problem and selecting important indices of performances and devicing methods to measure them. The fundamental philosophy is that unless one measures the process, he will never know how to improve. This phase is covered in four days of teaching, covering the following aspects:

- Importance of data, types of data – ordinal, nominal, measurable etc.
- Basic seven tools
- Process mapping and FMEA
- Probability and fundamental statistical distributions
- Process capability analysis

Each day consists of 7 hours duration – 4 hours of teaching and 3 hours of practicals. Process Mapping is nothing but a process flow chart through which one can find out the amount of non value adding activity getting added in system. FMEA (Failure Mode Effective Analysis) is given importance in the first phase. Second phase consists of Analysis of data. This is the fulcrum of the entire six sigma programme. In this phase, various decision making tools such as normal test, t-test, chi-square test, f-test, rank test etc. are taught in detail. Scenarios are created and participants are asked to take decision in a sequential form. This phase ends with a live demonstration of the famous technique called Gauge Reproducibility and Repeatability. Discussions are held to suggest remedial measures if gauge R & R is not OK. In the third phase improvement techniques such as Design of Experiments, Regression Analysis are covered. The course ends with development of detailed control plans.

In the project phase, each participant is asked to select a project covering Quality, Cost and Delivery. Currently FMEA approach for problem selection is advocated. There is a sponsor for the project who owns the outcome of the project. The current performance level is using defined past data or consensus approach (if no data is possible). A core team is developed consisting of the participant, the sufferer and the associates. The flag off date and the closing date are mentioned in a contract form. All the projects must be completed, results demonstrated and handed over to the system with necessary control plans.

Table 1: Some Results Achieved through Six Sigma Training

Project	Baseline	Achievement	Savings (Rs.) (lakhs/ month)
Reduction of Pay Slip error in Accounts Dept.	90 ppm	30 ppm	0.4
Reduction of form error in Double Gear	25 micron Error	less than 5 micron	8
Reduction of rejection due to horn failure	5/1000	less than 1 per thousand	5
Reduction of Rejection in Engine due to valve leakage	2%	0.5%	2

There are two types of participants – green belts and black belts. Green belts are those who carry out Six Sigma projects along with their normal work. Each green belt is required to complete atleast two projects per year. Black belts are the guides for green belts. Each black belt monitors six to seven green belts and the monitoring frequency is once a week. These black belts are in turn monitored by Master Black Belt. Each project is given a code number and at completion each project is documented.

Six Sigma Techniques

Few of the oft repeated techniques of Six Sigma are Process Mapping, FMEA and Gauge R & R. Process map is nothing but a flow chart of a system. In a problem solving approach, it is essential to know the flow of operation as well as information so that one can understand non value adding zones, and sources of variation. Removal of non value addition activity is essential to achieve cost reduction. A typical example is as follows (Fig. 1):

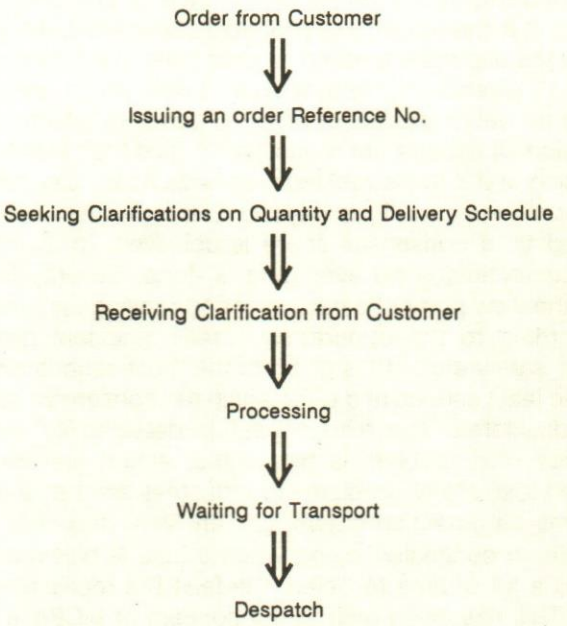

Fig. 1. Process Map (Sample)

In this sequence, seeking clarification and waiting for transport are non value adding activities. Removing them will smoothen the flow. Non value additions are removed either by dropping the activity or by empowerment. Along with the removal of non value adding activity, some documents are also removed. It is therefore recommended in Six Sigma Projects that process mapping must be used especially for non manufacturing areas. A process map is done in three steps:

(a) What according to you is happening?

(b) What is really happening?

(c) What is ideal happening?

Step (a) is done in board room after thorough discussions. Step (b) is called Walk in Exercise. In this all

members go to the problem area and physically watch and most of the times Walk in Exercise makes drastic changes in process mapping. (c) is the Bench Mark exercise. A concrete action plan with time targets set is made to achieve (c). In many of the six sigma projects this has resulted in great success called plucking low hanging fruits.

FMEA is a technique used in Reliability engineering and in Six Sigma has got wider applications. Essentially this technique does not require any data base but the experience and skill of experts are harnessed to get a good focus to the problem. It is a quantitative approach to problem solving. There are three components viz.: occurrence, severity and detectability. Occurrence is not necessarily the actual occurrence of a problem or effect. It is the possible or probable occurrence. Accordingly the experts are asked to rank them in a 1-10 scale, with 10 given to highly probable causes, and 1 given to least probable causes. In order to generate healthy discussion all experts are requested to give their individual ranking and if these rankings are wide apart, say, range (max rank-min. rank) is beyond 1, a rediscussion is initiated till a consensus score is achieved. In this particular technique no averaging is done. Severity is as per the view point of a customer and rankings are made according to the opportunity losses, accident proneness, safety etc. – 10 is given to the most serious and 1 to the least serious and once again the consensus score is considered. The third aspect is detectability. If the source of a problem is pinpointed, action can be initiated fast. Many problems in industries are not solved in time as detection capabilities are very poor. For example, in concealed wiring when a fuse is blown off, it takes a lot of time to detect the fault but repair time is low. This has given birth to the concept of MCBs. If the detection capability is very poor, then a score of 10 is given and very easy problems like surface cracks on a casting are given a score of 1. A most difficult problem is one for which all these three elements have 10, 10, and 10 scores. The product of all these three is called *Risk Probability Number (RPN)*. Without changing the design, a reduction in RPN is possible either by reducing occurrence or detectability number – while the first approach is through statistical process control, the second is done through innovation methods. Normally a time target of about 3 months is set and a target on revised RPN is set.

FMEA is a technique used in Reliability engineering and in Six Sigma has got wider applications.

Other Applications

Project Selection

Occurrence – Repetitiveness of the problem

Seriousness – Customer dissatisfaction

Solvability – Core competence, infrastructural facilities etc.

Spare Parts Control

Occurrence – Repeatability

Seriousness – Damage to system in case it is not available

Availability – Easy/difficult to procure.

Disposal of non-moving items in inventory

Occurrence – Possible usage in about six months

Seriousness – Damage to the system in case it is not available

Availability – Easy/difficult to procure.

Selection of Factors for Design of Experiment

Occurrence – Importance of factors

Seriousness – Criticality of factors

Controlability – Rigidity of control at the time of expts.

On the whole this technique employs the fundamental concept TQM also.

Gauge Repeatability & Reproducibility

This is one of the emerging techniques in Six Sigma. Since six sigma is management's Quality strategy, decisions are taken using data and instrument. If the R & R concept is understood for assessment only, no problem arises but if it is used for decision making, dicey situations arise. An example will illustrate this. Blood pressure of a normal person at about 40-50 years of age is 120/80. While taking B.P. readings of a normal man if the reading showed 140/100, the doctor can declare this person as a B.P. patient and can prescribe medicines also. But if the B.P. apparatus he is using has an error of 20 points, the entire medication may be disastrous. Hence the concepts of repeatability and reproducibility become very important.

While taking readings with instruments on non-

destructive items, variations occur due to instrument calibration, operator's prejudices with instrument called interaction random errors, environmental effects etc. Standards say that the error due to inherent or random variation should not be more than 10 per cent of the tolerance given. If it is more than 30 per cent, one has to procure new instruments which is very costly. In this context, Six Sigma approach can be used. A scientific planned experiment under simulated operating conditions is conducted to asses the contribution of various sub parts of the variation. Statistical techniques like Analysis of Variance helps in partitioning the total variation into different parts. Subsequent sections deal with different scenarios.

Case 1

Part variation	85%
Reproducibility Operator variation	4%
Reproducibility Interaction	1%
Repeatability inherent or random variation	10%
% R & R To Tolerance	10%

This is the ideal situation.

Case 2

Part variation	85%
Reproducibility	5%
Repeatability	10%
% R & R To Tolerance	10%

Capability exists but specification seems to be very rigid.

Case 3

Part variation	70%
Reproducibility Operator variation	20%
Reproducibility Interaction	5%
Repeatability	5%

Operator training is a must.

Case 4

Part variation	70%
Reproducibility Operator variation	3%
Reproducibility Interaction	22%
Repeatability	5%

The product may be flexi reference product like gasket, glass or characteristics may be inside bore dia meter measured through feeler gauge etc. In such cases, very exhaustive guidelines for checking with pictographs, followed by rigorous training are required.

Case 5

Part variation	40%
Reproducibility	30%
Repeatability	30%

Items for experiment have not been selected throughout the spectrum of specification.

Similarly, Gauge R & R studies are done for visual defects also. On the whole the technique tells that know the error in your system before taking any decision as every wrong decision increases variation.

Conclusion

Many processes under the influence of random variations exhibit a predictable pattern. If the patterns are understood and studied properly, one can predict the future with a reasonable degree of accuracy. This helps in anticipating a problem so that necessary preventive actions are thought of. The behavioural pattern of many processes are found to follow Normal pattern ±3 Std. deviations. Six Sigma Spread covers 99.73 per cent of the individuals to lie within a band. The entire spread of the process is within customer specification, with customer dissatisfaction level very low. This is the fundamental spirit of Six Sigma programmes.

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Focus

Mass Customisation in Apparel Manufacturing

Rajesh Bheda

Today's Apparel manufacturing has almost reached the same place where the evolution of apparel manufacturing started. This full circle started with customised garments stitched for a particular person by a master tailor. The availability of technologies for mass production of apparel and need to lower production cost propogated large scale manufacturing of ready-made garments. With customers asking for more variety of products, the concepts of flexible manufacturing and ability of processing smaller order quantities came in to forefront. However things did not stop there, the technologies and systems available today and the developments attempted will be able to satisfy most of the individual needs of a customer for a customised product, which in concept is similar to custom made, but is delivered using 'Mass-Customisation'.

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The only constant in the fashion industry is 'change'. With the invention of sewing in 1848 the productivity of sewing activity increased drastically compared to hand sewing. Tailors engaged in the custom tailoring business, slowly started producing a few popular types of garments for common size customers. This trend formed the basis for further spread of ready to wear concept. Armed forces in different countries needed standard size uniforms, creating a need for large scale manufacturing facilities. As the cost of labor started rising in the western world, made to measure garments became expensive and preference shifted to mass produced garments which were relatively economical and also offered advantage in terms of procuring instantaneously. Developing countries like India also saw this transition in customer preference for ready made garments during 1970's, 80's and 90's.

Mass produced garments brought with them many advantages in terms of new styles, consistent quality, better finish achieved due to use of special machines and most importantly the ability of buying the product when needed. But alongwith these advantages came the disadvantages in terms of standard sizes. A customer had to accept a little short or long sleeve in his shirt. Trouser waist could either be thirty-four inches or thirty-six inches. Person with thirty-five inches waist had to wear a too tight or loose trouser. Today's customers are not too happy with products which are not most suited to their needs. That's why more and more variety is being offered in the market to cater to these ever changing needs of customers. The desire of today's customer to have special products for their special needs is very high. Mass customisation is the answer to satisfy those customers who wish to avail the benefit of customisation without losing the rewards of mass-production.

What is Mass–Customisation?

Extensive research has been carried out in USA

and Europe on application of mass-customisation in apparel industry. Fralix (1999) says "Mass-customisation has emerged as a practice that combines the best of the craft-era with the best of the mass-production-era. Not to be confused with custom-made, mass customised products may still be manufactured in relatively large quantities; however, each item might be slightly different based on the needs and desires of the individual customer." Pine (1993) refers to the goal of mass-customisation as being to provide enough variety so that the wants of the customers are satisfied, whereas the goal of mass production was to produce at sufficiently low cost so that every one could have one.

Mass-customisation need not be taken to mean that everything about the product can be customised; features to be selected for customisation should be those considered important by the customer and customisation process need not increase manufacturing cost apart from the initial investment in technology required.

Why Mass Customisation?

The answer to this question is that it is the only way one can satisfy today's demanding customer who is not satisfied with a standard product. To illustrate the point further, a recent research study conducted in Germany by University of Muenster aimed at finding out the satisfaction levels of customers shows revealing results. As high as 75 per cent respondents had to alter the men's suits bought by them from the retailer due to size or fit problems. As shown in Fig. 1 the percentage alteration needed in other garments is lower but is still quite high. The respondents of the study also revealed that they do not mind paying 5 to 10 per cent additional cost to receive a product customised to their needs.

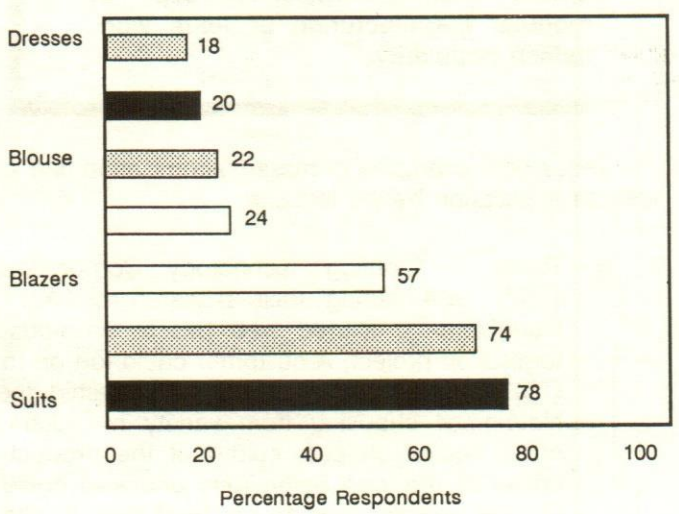

Fig. 1. Percentage of Consumers facing fit related problems in different types of garments

Technologies supporting Mass-Customisation

Success of mass-customisation depends on the ability of the organisation to gain information on customer's exact needs, motivation of the workforce to accept responsibility of fast track mass customised orders and supporting technologies to make the mass customisation happen. Several efforts are being made world-wide to develop technologies, test them for real application so that mass-customisation can capture significant market share in years to come. The main contributing technologies and systems (Fig. 2) which significantly contribute to success of mass customisation in apparel industry are:

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- Body Scanning for contactless extraction of body measurements
- CAD systems for made-to-measure pattern making and marker making
- Single ply computerized Cutting
- Digital printing
- Computerized Embroidery/Logo Design machine

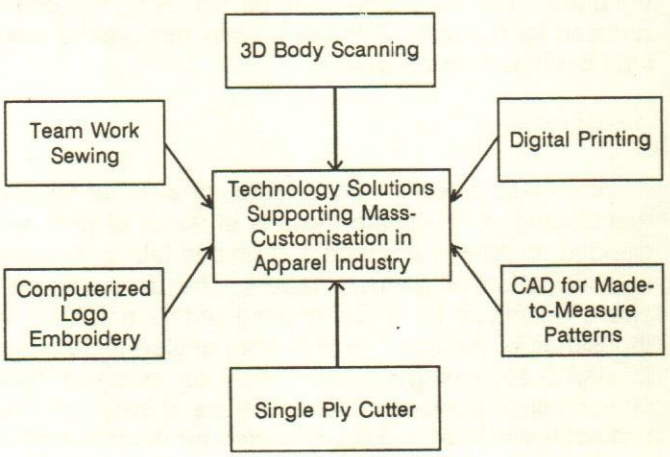

Fig. 2. Technology Solutions Supporting Mass-Customisation in Apparel Industry

- Team Working/Modular Manufacturing in Sewing

Body Scanning

The major problem associated with mass produced garments is that they are not produced as per the body measurements of persons. Through body scanning a three dimensional (3D) image of the customer is generated to obtain critical body measurements. Customer can have these measurements stored on a personalised data card which can be used in future. The 3D body scanners developed by $(TC)^2$, USA, Techmath of Germany and Telmat of France work on similar principle of using laser beams to generate body profile. After the initial test runs, many retailers have started installing these scanners.

CAD systems for Made-to-Measure Pattern Making and Marker Making

Most suppliers of CAD systems for pattern making are currently making efforts to improve abilities to create accurate made-to-measure patterns. The body measurements data generated by 3D scanners can be received by a pattern making CAD system with modules on custom-fit. This generates a customised pattern for the customer and works out a cutting layout.

Single Ply Cutter

In recent years the computerised cutter manufacturers have started offering cutters for single ply to support the demand for mass-customisation. The body measurements of a customer can be transmitted from the Body scanning, in the retail outlet alongwith the fabric and style requirements to manufacturing plant. The customised garment patterns transmitted to single ply cutter shall instantaneously be cut using the fabric required for the style. This will virtually remove the waiting time in cutting room.

Digital Printing

For mass production of apparel, or even for flexible manufacturing, the fabric designs in terms of print are decided months in advance and printed fabric is stored in anticipation of garment orders. The minimum purchase quantities for these printing orders could be in thousands of meters. The shift from analog technology to digital technology is also likely to influence how fabrics will be printed in future. The use of inkjet printing technology is likely to be best suited for the purpose of printing apparel fabrics. Even though it shall take further development in the technology to reduce the cost of per meter printing as well as durability of print, this technology is likely to transform the customisation ability and scope of mass-customised products.

Computerized Embroidery/Logo Sewing Machine

This machine can be used for producing a customised logo selected by the customer on his/her garment. The retailer can give options of logos for which ready programmes are stored in this machine. This form of customisation is catching up fast with the providers of mass customised apparel products.

Team Work/Modular Manufacturing for Sewing

In the mass production era, the western factories could have 300-400 workers producing the same products/style using highly specialised sewing work stations. As the need for introducing flexibility intensified and ability of producing small orders became critical for survival in the western world, the concept of modular manufacturing or team work gained popularity. Modular manufacturing or team work in sewing section of apparel factories works on the principle of using teams of approximately 6 to 10 multi skilled workers operating multiple machines attempting to produce garments in least throughput time. The group is responsible for the planning of job allocation, quality of the product and productivity performance. This has, in many cases, brought down the sewing throughput time from weeks to hours. The output of these teams is ready to be sent to store or customer directly.

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These brief examples of mass-customisation can illustrate application by the industry.

- Textile & Clothing Technology Corporation $(TC)^2$, USA during their research on Agile Manufacturing started web based mass-customisation project. A customer could log on to $(TC)^2$ website and customise a polo-shirt for him/herself choosing from variety of collars, cuffs, pocket shapes, colour of the product, colour of the logo embroidery and also could choose specific logo to be produced on the product. The order could be placed on the web-

site. The orders received before 4:00 pm on any day were produced and dispatched to customer by next evening, using few of the technologies discussed and the Agile work force of $(TC)^2$.

- High Tech Perfection is a chain of shops in Germany and few European countries. Through their twenty-one retail outlets they provide mass-customised men's-wear services. They use 3D Body Scanners to capture the measurements of the customer. Measurement and customer preference in terms of style and any other details are sent to the factory electronically and a mass-customised product is delivered in less than a week's time.

Conclusion

There will always be customers who will go for standard mass produced products. However, the number of customers looking for customisation is increasing rapidly. Specially in apparel products, the customer desires it to be unique to himself or herself. Technologies are available today to provide the benefit of mass customisation to these discerning consumers. In coming years, the additional cost of providing mass-customisation is likely to go down substantially and the entire process of placing order to delivery of product will become relatively seamless.

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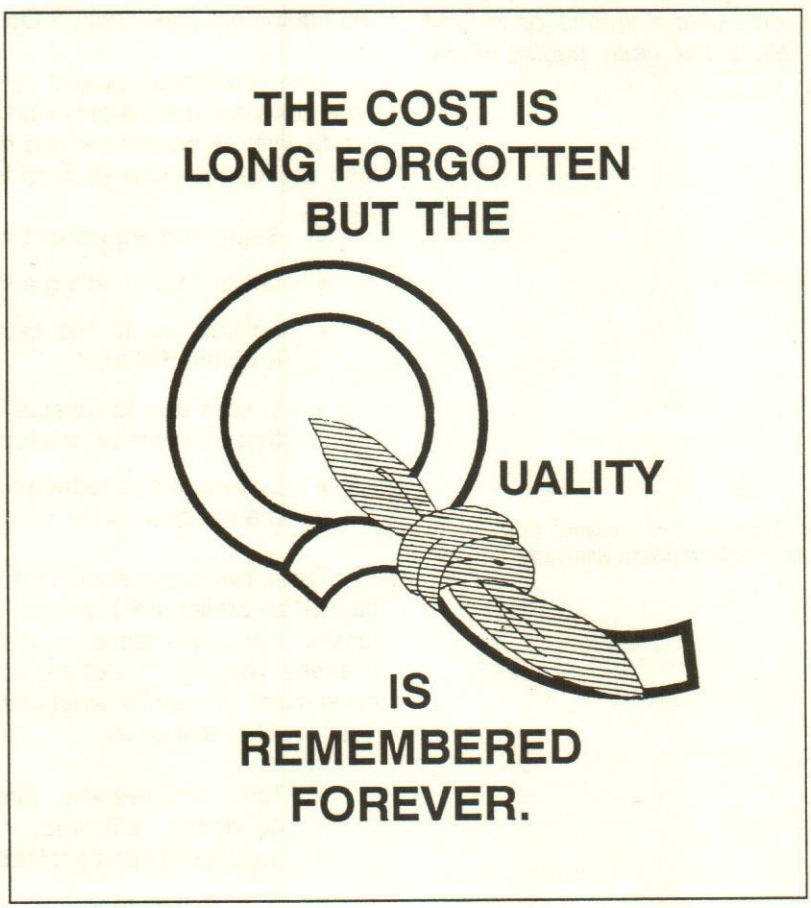
MANAGEMENT THOUGHTS : BY PRAMOD BATRA



□ Think Inc., Batra

Management of Productivity through TPM

Bikash Bhadury

Total Productive Maintenance (TPM) is a practical technique developed specifically for manufacturing organisations. This paper looks at both the need for and actual implementation of TPM. Three case studies have been presented. The need for implementation of TPM is brought out through the analysis of data from the jute industry. The various aspects of implementation of TPM are illustrated with the help of two case studies in tyre manufacturing industry.

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Total Productive Maintenance (TPM) is a concept much in vogue today and is directed at using production equipment optimally for manufacturing desired quality products. Whereas preventive maintenance is performed to 'keep or retain' an equipment or machinery, in satisfactory operational condition and includes periodic lubrication, calibration, replacement, overhaul, equipment inspection and also detection and prevention of incipient or random failures, productive maintenance has a much larger objective. 'PM activities mean not only preventive maintenance, but also a wider PM that focuses on the life time economic feasibility' of the equipment (Takahashi & Osada, 1990).

Loss production caused by equipment and machine breakdowns is not the only kind of loss which affects the productivity of equipment and machines. Productivity is also affected by other kinds of losses, such as:

- Setup and adjustment losses
- Losses due to idling and minor stoppages
- Losses due to reduced speed or operation at less than full load
- Losses due to defects in process and production of defective products
- Losses due to reduced yield from the startup of the machine to the point of stable production.

These five together with the losses due to downtime caused by equipment breakdowns are called the 'six big losses' and cause reduction in overall equipment effectiveness. The objective of productive maintenance is improvement of overall equipment effectiveness. Thus, 'total' in TPM stands for:

- Total effectiveness aimed at the pursuit of economic efficiency and improvement of productivity and profitability
- Total maintenance which must include not only periodic, or routine, preventive maintenance activities but also condition-based maintenance of

plant and machinery, building in of reliability and maintainability features, plant modifications and other activities aimed at maintenance prevention and designing-out-of-maintenance.

Moreover, total also includes total participation, which, in turn, is achieved through a motivated workforce, job enlargement of production operators, maintenance skills training of maintenance tradesmen, and small group activity in every department and shop and at every level of the organisation.

The three identifying characteristics of TPM are: stress on the elimination of the six major equipment losses, autonomous maintenance, and use of small group autonomous activity for TPM promotion. Breakdowns of production equipment result in loss of availability, or productive capacity, and preventive maintenance, including both the periodic and predictive kinds, is aimed at improvement of equipment availability. This 'breakdown loss', or loss of availability, is widely recognized. However, what is not recognized is that a significant amount of productive time is lost on account of idling and minor stoppages of production equipment and their setup and adjustment. Autonomous maintenance is maintenance and care of production equipment by the operators themselves, and this can help reduce not only breakdown loss, but also losses due to idling and minor stoppages and other equipment-related losses. However, implementation of autonomous maintenance calls for a fundamental change of attitude in employees – moving away from the 'I operate, you fix' syndrome. This change of attitude implies cooperation and recognition of the fact that operations and maintenance are inseparable when it comes to the job of looking after production equipment and machines.

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Need for TPM – A Case Study

A case study conducted on the drawing process in a jute mill will be used to illustrate the need for implementation of TPM. A jute mill is a facility which converts raw jute into hessian cloth, jute sacks, carpet backing cloth and also jute yarn for sale. It is a good example of a continuous process operation, where a number of mechanical processes are used to first convert the raw jute to sliver (combed and prepared fibre) by the processes for selection, softening, carding and drawing, then to produce yarn from the sliver by the process of spinning, and then finally to produce end products like, hessian and sacks from jute yarn by winding, beaming, weaving, and the finishing operations, namely, damping, calendering, and cutting and sewing for a sack and lapping and packing for hessian. The sequence of operations/processes involved is shown in Fig. 1. The quality of yarn dictates not only the quality of the end products, but also the productivity of winding, beaming and weaving operations which follow spinning. Also the quality of yarn produced by spinning, in turn, depends on the preceding operations, namely, selection, softening, carding and drawing.

After selection, raw jute is softened in the softening machines, conditioned, and the softened and conditioned jute is then passed through the breaker and finish carding machines. These machines pull and comb the jute to produce sliver. Drawing is a process which is used to reduce the width and thickness of sliver. The material from the finish carding machine is passed through three stages of drawing. For the drawing process, industry practice does not vary much and same/similar machines are used by all jute mills. Work sampling studies carried out on the three stages of the drawing process showed that the idle time on these machines was very high. Based on this, it was decided to conduct production studies for a period of 8 hours on each stage of the drawing process to identify the various reasons for machine idling. These studies were carried out in two mills, which will be termed mills F and G, to get a more balanced idea of the reasons for the loss of productive capacity and the percentage contributions of these reasons.

The data obtained from the six production studies (three stages and two mills), have been tabulated and presented in Table 1. The four main causes of idling of machine are pin breakage, jamming, loading and unloading of drums (with combed sliver) at input and output sides of the machine, and non-availability of operator. Further investigation of these four causes of idling revealed the following:

Pin breakage: Generally occurs due to the uneven thickness of the sliver and defects in the carriage of the machine. Whenever a pin breaks, the machine stops automatically and the operator informs the maintenance department and asks for replacement of the broken pin (by a new one). The activity of replacement is very simple and the actual replacement time varies from 30 seconds to 1 minutes. However, the machine is idle for 3 to 14 minutes, since informing maintenance and assigning of a maintenance technician for the task

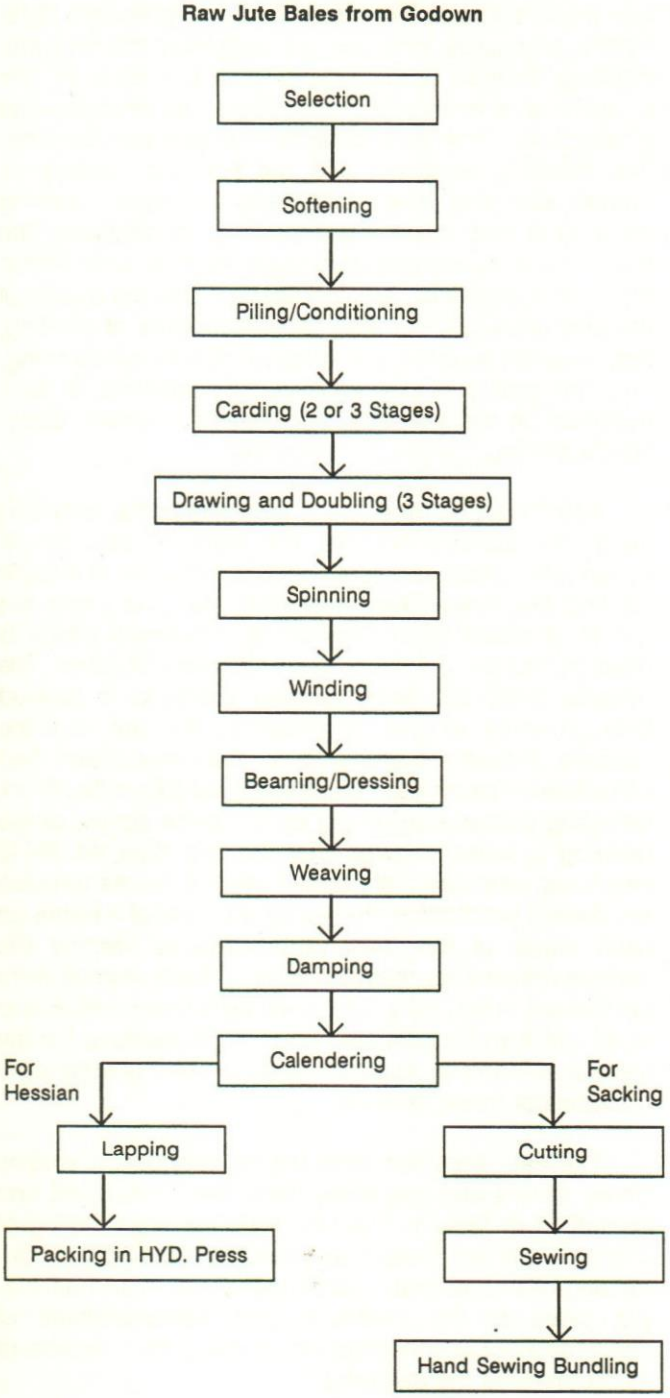

Fig. 1. Processing of Jute – From Raw Jute Fibre to Hessian and Sacking

take time in addition to the time taken by a technician to come to the machine and replace the pin. Pin breakage is a fairly frequent event. It is also a random event and forecasting the number of breakages in a shift in different stages of drawing is quite difficult.

The operator can very easily replace the broken pin himself. From the production studies, the average number of pin breakages during a 8-hour shift was found to be 8. Thus, if the operator had replaced the pin himself, the machine would have been idle for a maximum of 8 minutes in a shift, on this account, as against an average of 47 minutes, resulting in a reduction of idle time by nearly 40 minutes in a shift of 480 minutes.

Jamming: Generally jamming is caused by the following: driver jam at the auto-stop rod, bar jam, sticking of the sliver at the rubber pretting roller, and sliver breakage at the input side. Whenever jamming occurs, the machine stops automatically and the operator takes necessary action to restart the machine. Jamming occurs very frequently. In the studies, the average frequency of occurrence of jamming was found to be 18 per shift. Whenever jamming occurs the machine is idle for 30 seconds to 3 minutes and more often, it is around 3 minutes.

Except for sliver breakage at input side, the incidences of jamming are machine related. Therefore, to reduce idle time due to jamming, the operator has to pay attention to routine maintenance, specifically activities of cleaning of machine surfaces and rollers, lubrication and bolting. Moreover, it is estimated that 50 per cent of the time lost due to sliver breakage can be saved if the operator is alert and promptly repairs sliver breakage at input side. During the studies, the time lost due to jamming averaged at around 57 minutes in a shift, of which two-third was found to be machine related and one-third due to sliver breakage. Even if only 50 per cent of the sliver breakage related time can be saved, then about 10 minutes can be saved if the operator is alert and takes corrective action promptly.

Loading and unloading of drums: The operator stops the machine when the drum at the output side is full of material. He unloads the full drum, loads an empty drum in its place and restarts the machine. He also sometimes stops the machine to load material at the input side. Loading and unloading of drum at both input and output sides can be done while the machine is running. The operator should be trained to do this, and if this is done, it is estimated that 75 per cent of the time lost on this account can be saved. The average time taken for loading and unloading was found to be around 27 minutes, and thus with adequate training and practice, around 20 minutes, in a shift of 480 minutes, can be saved. This is as much as 4.17 per cent saving of productive time.

Non-availability of operator: Generally at the time of shift change, the operator stops the machine and leaves about 5 to 10 minutes before the end of his shift, and the operator of the next shift starts the machine 3 to 5

Table 1: Results of Production Studies – Reasons for Machine Idling with Respective Contribution (% idling)

State of Drawing	Mill	Total Percent Idling	Reasons and corresponding idling per cent contributed						Total Per cent Working
			Jamming	Pin Breakage	Loading & Unloading of material	Operator not available	Material not available*	Miscella-neous**	
First	F	35	16.25	12	10	5	–	1.75	65
	G	27	14	10	–	2	–	1	73
Second	F	36	10	12	6	7	–	1	64
	G	26	9.37	10	3.75	1.66	–	1.22	74
Finish	F	33	10	4	11.3	5	10.0*	2.7	67
	G	30	11	11	3	3	–	2	70

Note: * This is an isolated case and a rare happening. Poor quality of jute at input side is the main cause for non- availability of material.
** Includes cleaning, oiling and power failure.

minutes after his shift starts. So, in every shift, from 8 to 15 minutes are lost on this account. From the production studies, the average time lost was found to be 18.91 or 19 minutes. This unnecessary loss can be totally eliminated with greater organisational discipline and operator involvement. The operator should hand over the machine in running condition during the change of shift. This will result in a saving of 3.5 to 4 per cent.

Application of Productive Maintenance

The project of application of productive maintenance was undertaken for the mixing and rubber preparation section of a tyre manufacturing plant, known as the Banbury section [Bhadury, 1998]. This section had been plagued with poor equipment availability, which was affecting production of tyres. The management of the company was, therefore, interested in improving equipment availability of this section as the first stage of tyre production is carried out here. In this section, rubber compound is prepared in the form of sheets for the rest of the tyre plant. The section has four units (and each unit is also called a Banbury and given a number, namely, 1, 2, 3, and 4). Each unit, in turn, consists of the following subsystems:

- Carbon weighing and feeding system
- Polymer weighing and feeding system
- Oil weighing and feeding system
- Internal mixer
- Extruder with R/D calender (for Banburys 1 and 3), and DC and AC mills (for Banburys 2 and 4)
- Batch-off unit.

The outline diagram of a unit showing the different subsystems and equipment is given as Fig. 2.

The carbon black is loaded into the six day storage bins C1, C2, ..., C6. A screw feeder with a cut-off valve is fitted beneath each day bin to ensure accurate feeding onto the weigh scale. The material is fed into the internal mixer through the flexible discharge and fluidised mixer entry chute. The polymer is weighed on the polymer band scale, and the operator can load either bales of rubber by hand or rubber sheets using the sheet feeder. After the required weighment, the polymer is transferred to the intermediate conveyor, where it is held till it is called for by the internal mixer. Oil is stored in three heated day tanks and when required by the mixer, is routed to the oil scale. After weighment, the oil is pumped to the mixer with the help of the injector pump. The purpose of the internal mixer is to mix to ingredients and to make a compound. The ingredients (carbon black, chemicals, oil and polymer) are mixed with the help of two flanged rotors driven by a 1500 H.P. motor. After the mixing is over, the mix is discharged through the discharge door onto the extruder/DC mill. The compound is further mixed and formed into rubber sheets in the extruder with roller die calender/DC mill and AC mill. The batch-off unit cools and stacks up the rubber sheets of a batch.

The equipment downtime data for the four Banburys was collected for a six-month period from the monthly delay time register maintained by the industrial engineering department, and shift log book maintained by the maintenance department. It was found that data regarding setup and adjustment loss was not available. Moreover, losses due to poor product quality, low capacity utilisation (or speed loss) and low yield/productivity at startup and restart did not seem to apply to this section. Under the circumstances, the downtime loss was classified under two main heads of breakdowns and stoppages. Breakdowns are caused by component or equipment failure or defect, whereas stoppages are caused by jamming/sticking of material

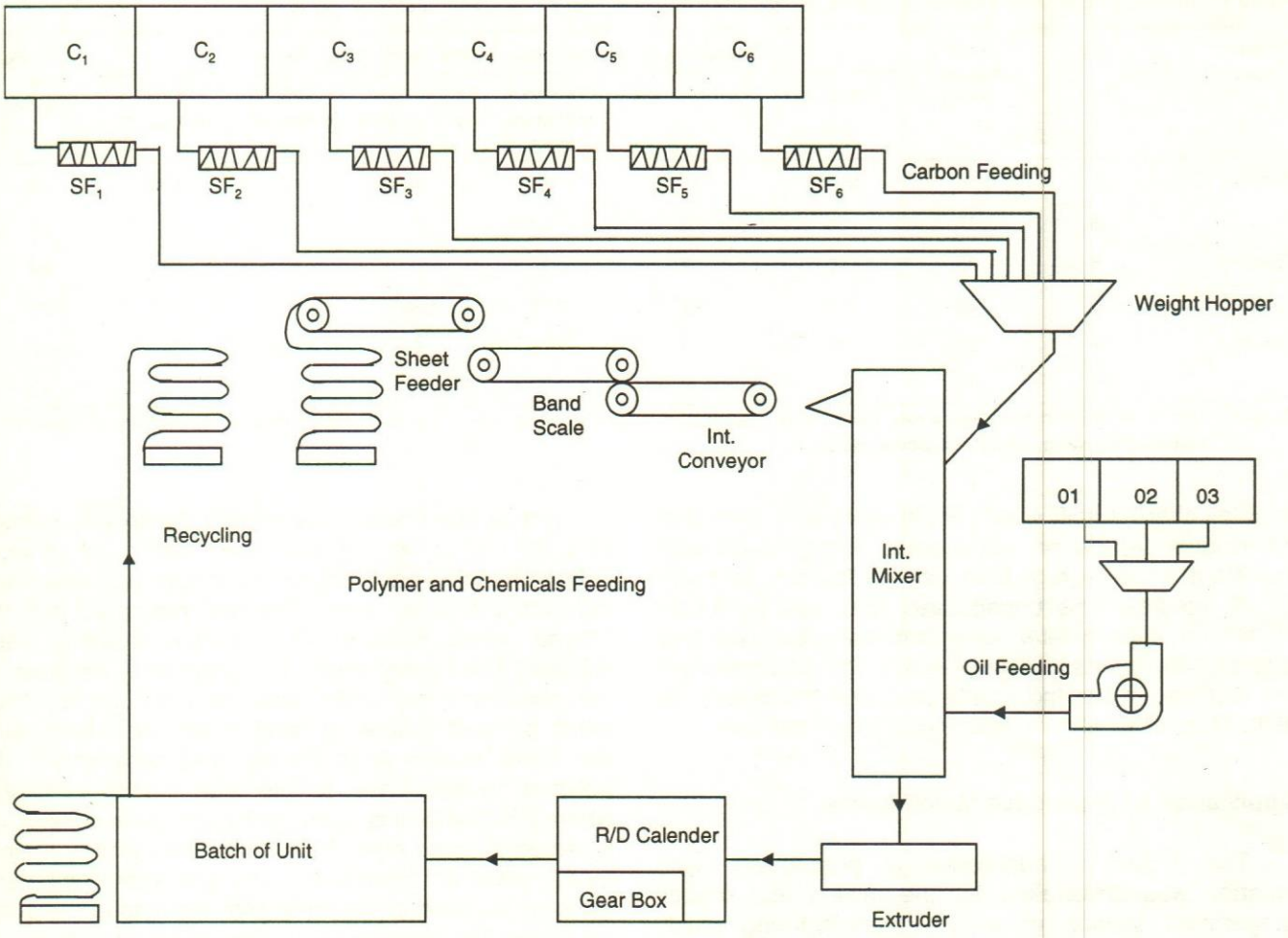

Fig. 2. Outline Diagram of Banbury Unit (Banburys 1 & 3)

(carbon black and rubber) in chutes and racks, malfunctioning of components such as limit switches, valves and air cylinders, and loss of signal resulting in the operation of interlocks stopping the equipment.

The causes of downtime were divided into the following four classes: breakdowns, stoppages, preventive maintenance (PM) jobs and other causes. A list of other causes is as follows: late start time, loading stopped by workmen due to personal reasons, power failure, material shortage, empty skid not available, absenteeism, chemical not ready, change of power supply, work stopped due to technical follow-up, unmixed batch dumped and compound change-over.

Analysis of downtime data was carried out for the entire section (all the four units together) and also for the four units separately. The downtime in Banbury section during the six-month period was found to be a significant fraction of the total available time. For the entire section the downtime was 36 per cent of the total time. From the unit-wise analysis of data, it was found that downtime for the four units varied from 34.3 to 37.4 per cent. Thereafter, further analysis was carried out with the data classed under the four heads as noted earlier. The distribution of downtime for the Banbury section during the six-month period is given in Table 2.

Table 2: Downtime Distribution for the Four Banbury Units

Unit	Total down-time in per cent	Breakup of downtime under four heads			
		Break-down (%)	Stop-page (%)	P.M. (%)	Other (%)
Banbury 1	37.4	8	25	22	45
Banbury 2	36.7	3	26	22	49
Banbury 3	34.3	8	31	09	52
Banbury 4	36.6	4	25	35	37
Banbury Section	36.0	6	26	22	46

The following conclusions were drawn from the analysis:

- Availability was only 64 per cent and there was,

thus, a need to take appropriate measures to reduce downtime.

- Downtimes on account of stoppages, preventive maintenance and other causes were found to be significantly higher than that due to breakdowns – for the section as a whole, only 6 per cent as compared to 26, 22 and 46 per cent.
- Loss of availability due to other causes was very high. Also since these causes were not under the control of maintenance department, appropriate steps to minimise this loss should be taken by the plant management.
- Machine downtime for preventive maintenance was on the high side and needed to be reduced. Proper planning and scheduling of preventive maintenance jobs and a computerised maintenance management information system for scheduling and control were recommended.
- Stoppages accounted for as much as 26 per cent of the total downtime and nearly four and a half times of that for breakdowns. Whereas, downtime for each stoppage was comparatively small, the number of stoppages was very large.

Subsequently, a detailed analysis of all breakdowns and stoppages, which accounted for one-third (6 + 26 = 32 per cent) of the loss of equipment availability, was carried out to identify the vital stoppages and breakdowns. This analysis revealed that out of a total number of 163 failures and stoppages, the first 60 (ranked according to the total downtime per month) accounted for 80 per cent of the downtime. The remaining 103, not only accounted for just 20 per cent, but also had very low frequency of occurrence (number of occurrences per month did not exceed two, with most occurring only once during the month). Based on this, it was decided to concentrate on the first 60 breakdowns and stoppages. Further, analysis showed that the first 60 consisted of only 9 breakdowns, whereas 51 were stoppages. Moreover, since the taking up of 60 problems was a difficult proposition, it was decided to do the task in two phases, concentrating on a smaller number of problems in the first phase, and after the successful completion of the first phase, taking up a large number in the second phase.

A closer study of the first 60 failures and stoppages revealed that the first 18 accounted for 50 per cent of the downtime and the remaining 42 accounted for the balance 50 per cent. Accordingly, it was suggested to the management that in phase 1, the first 18 problems should be tackled, and after the successful completion of phase 1, the remaining 42 should be taken up in phase 2.

Coming next to the first phase of implementation of productive maintenance for the Banbury section, closer observation showed that the first 18 problems consisted of 15 stoppages and 3 breakdowns. The incidence of these breakdowns and stoppages could be reduced by taking certain preventive actions. These, in turn, could be in the form of maintainability improvements, autonomous maintenance, or preventive maintenance, which could either be periodic (not daily) preventive inspections, or preventive replacements. Three out of the 18 problems (or out of the 15 stoppages) were identified for maintainability improvement efforts. The relevant details for these three stoppages are given in Table 3. These three problems were subjected to critical analysis. In the first case, it was found that jamming is caused by the clogging of rubber pieces and other materials in the suction pipe of the pump. This problem required a minor modification to the plant consisting of the incorporation of a filter to the end of the suction pipe dipped in the slurry tank. In the case of the other two problems, maintainability improvement took the form of the incorporation of improved operating procedures. The remaining 15 problems were also taken up and for each problem, the necessary preventive action was determined, and the frequency of the preventive action, either preventive inspection/check (in most cases) or preventive replacement, was decided upon.

Table 3: Stoppages Identified for Maintainability Improvement Efforts

Description of problem	Frequency (occurrence per month)	Average downtime in minutes	Total downtime per month
Slurry pump jamming	11	28	308 minutes
Band scale problem	10	16.5	165 minutes
Carbon leakage and carbon jamming in chute and screw feeder	3	53	160 minutes

Moreover, if the preventive action necessary was in the form of daily cleaning, lubrication and bolt tightening, or simply daily/routine checking/inspection, then it was proposed for inclusion under autonomous maintenance to be carried out by the equipment operators. Simultaneously a computerised maintenance management information system, based on a comprehensive data base, was designed and the job of its implementation was taken in hand. The proposed system had the following desirable features:

- It was user-friendly and also had the query facility.

- It permitted detailed and varied type of analysis.
- It could be used not only to produce different types of regular and special reports to support managerial decisions but also could serve as a decision support system for planning of maintenance activities, both preventive and corrective in nature.

Implementation of TPM in a Tyre Manufacturing Company

A study was undertaken in a company—the second largest tyre manufacturer in the country [Bhadury, 1998]. In recent years, however, competition, both domestic and foreign, had been threatening its position. It had become necessary, therefore, to further improve the product quality, and simultaneously reduce the manufacturing cost. To further improve its quality image and increase exports, the management of the company had also decided to work towards obtaining an ISO 9000 certification.

The manufacturing unit of the company was headed by a Vice President and employed over 3,000 persons. The technology used was state-of-art and the production shops were also well laid out. Moreover, since quite a few years the unit had been following the traditional system of preventive maintenance and also 100 per cent inspection of the product at various stages throughout the manufacturing process. Certain drawbacks of the existing system had recently come to light and were follows:

- Only preventive maintenance had not been useful in correcting recurring defects,
- 100 per cent inspection had essentially been a process of sorting good products from bad and had been far from cost-effective.

In addition to this, the operators had little responsibility for quality and no apparent incentive for building a tyre right the first time. The quality control department acted as a "police force" trying to enforce corrective action after a defective item was found and thus, inspection by the quality control department had been directed only at defect detection and no attempt had been made at defect removal. The quality and productivity performance had not been upto the expectations of the management. Equipment availability in some critical processes such as curing, had also been a nagging problem. Any attempt at improving product quality and reducing the number of breakdowns had always been met with a call to increase the number of inspectors, and the resulting increase in the number of inspectors and maintenance tradesmen had not always borne fruit.

The company manufactures heavy duty tyres, such as truck tyres, and tyres for tractors and earthmovers etc. A tyre is a composite of rubber, fabric, beadwire, carbon black and chemicals. All these components are mixed and processed together in the raw state to form a green tyre. To get the required properties, a green tyre is cured in a curing press by a process called vulcanisation. The various processes used in the production of a tyre, and accordingly, the production departments of the manufacturing unit were as follows: Mixing, Calendering, Bias cutting, Band building, Extruding, Truck tyre building and Curing.

For curing, the unit had various sizes of curing presses to suit various tyre sizes. Fig. 3 gives the flowchart showing the various processes used in the production of a tyre.

The long and extensive process of manufacture of a tyre demanded constant coordination between departments since otherwise delay at any intermediate stage would show up in the end, either on account of the loss of green tyre (LOGT), or due to sporadic breakdowns. The adverse effect of LOGT could be minimised by ensuring that a particular tyre, which was either low in inventory or had an immediate demand, was built. This could also be done when there was either a shortage of personnel in a particular shift, or a breakdown on one, or a couple, of the tyre building machines. The only place where the timings, or production, could not be so adjusted was the curing department, because the cycle time of curing for a particular type of tyre was fixed. Thus, delay, or loss of production, on account of LOGT was not expected, and had in fact been rarely observed. However, curing was the last stage of the manufacturing process, and the product obtained after curing directly affects the "output". In the curing department, it was further observed that one of the bag-o-matic presses—the E-2 press—was scheduled for overhauling and during overhauling, the following problems had to be attended to:

- Right side inner bull gear bushes had moved resulting in the lubricating oil not reaching the seal.

The long and extensive process of manufacture of a tyre demanded constant coordination between departments.

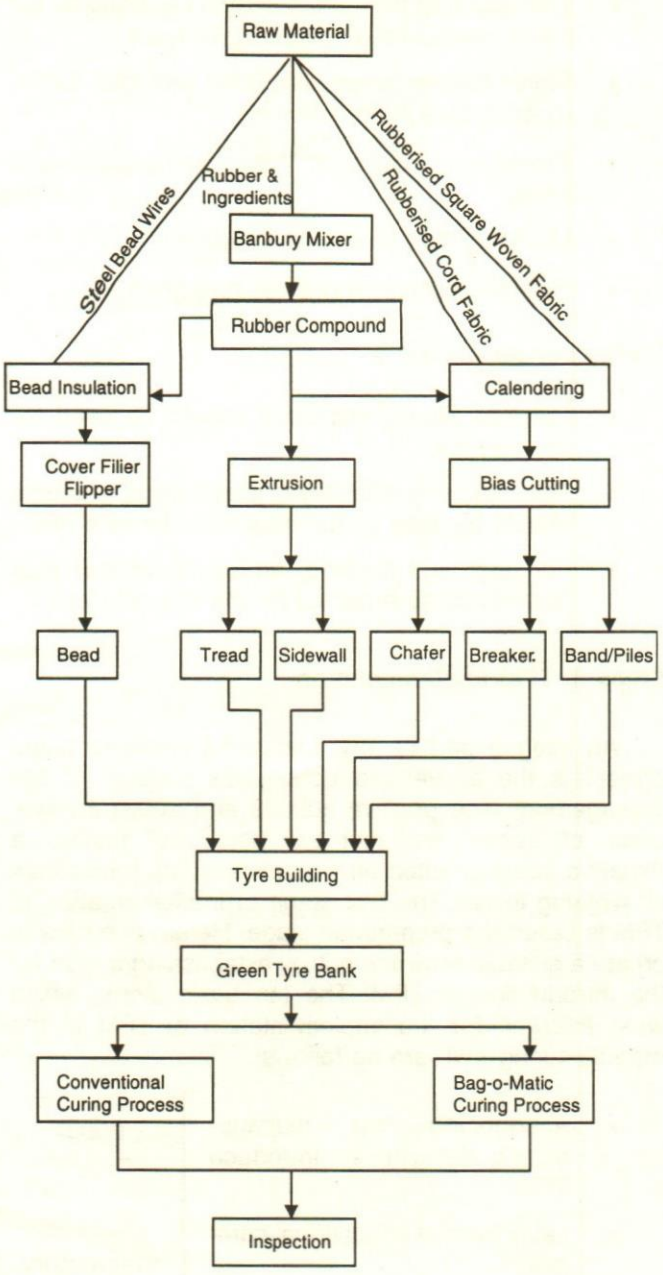

Fig. 3. Flow Chart—Production of A Tyre

- The hydraulics of the press was in bad shape and had a lot of problems.
- The valves of the press, besides the pipelines, had a number of leakage problems.

Moreover, the performance of the E-2 press had been far from satisfactory and in the last six months, its overall effectiveness had never crossed 60 per cent. As an illustration, the weekly performance figures of the E-2 press (for a period of one week—on a daily basis—as submitted to the management) is given in Table 4.

Table 4: E-2 Press Performance

Day	Number of tyres cured	Availability	Performance Rate	Quality Rate	Effectiveness (per cent)
1	24	0.777	0.750	0.875	50.99
2	30	0.870	0.833	0.867	62.75
3	28	0.836	0.813	0.712	48.39
4	32	0.892	0.871	0.812	63.08
5	8*	0.667	0.602	0.750	30.09
6	24	0.739	0.788	0.833	48.52
7	30	0.833	0.875	0.833	60.71
1-7	176	0.801	0.790	0.811	51.32

*Sunday/Holiday

Since curing is the last stage of the manufacturing process and the performance of the curing department affects both quality and quantity of output, it was decided that TPM implementation should start from this department. Also it was decided to take the E-2 bag-o-matic press for implementation of TPM.

For effective implementation of TPM, not only should one know which particular area of the plant is experiencing problems, but also be able to identify these problems and their solutions. The first task was thus to preferably get all employees from the top management to the operators on the production line for discussion on a common platform and to get their views and suggestions on improvements. From this point onwards, a series of brainstorming sessions on specific areas of the problems were held with a view to pinpoint optimal solutions. A large and extended team comprising the top management, managers of different functions, such as production, engineering maintenance, electrical maintenance, technology (rubber technology, as in the preceding case) and R & D, supervisors and shop floor workers, both from maintenance and production, was formed for this purpose. Close monitoring of parameters and performance at all levels assisted in the understanding of the equipment and development of effective countermeasures.

For the effective implementation of TPM, not only should one know which particular area of the plant is experiencing problems, but also be able to identify solutions.

After many such brainstorming sessions, a number

of improvements were identified for the E-2 press. These improvements were classified under three heads, namely engineering and technical, production, and energy conservation:

Engineering & Technical Improvements

- Sinclair Colin diaphragm valves should be used for increased reliability and easier maintenance.
- The hydraulic unit should be raised on a platform and should be improved by the provision of rupture discs.
- In addition to rubber cup washers, brass piston rings should be used.
- Grease-based lubrication system should be used for improved lubrication and better monitoring.
- Better quality teflon gaskets should be used for the main cylinder and dome to reduce leakages.
- Both the dome grooves should be repaired.
- For greater reliability, the pressure switches should be relocated, the diameter of the copper tubes should be increased and bleeding points should be provided (in the copper tubes).
- Strain gauges should be provided on both arms.
- Valves and pipelines should be standardised as per the L & T presses.
- Solenoid valves should be relocated for easier access.
- All bends and fittings should be of the forged socket weld type.
- Diameter of the dome steam condensate pipe should be increased (for improvement of water removal).
- Bottom dome opening (provided for removal of water) should be made.
- In place of conventional timer, PLC should be used.
- Leslie valve should be provided for better and individual shaping control.

Production Improvements

- Two separate hydraulic valves should be provided for individual cylinders to avoid delay in cylinder movement.
- The near and front arms should be adjusted for the convenience of unloading of tyres.
- Signal blinker lamps should be provided for indicating cure malfunctioning.
- Provision of bladder stripping during shaping of tyres.
- Mould lighting should be improved.
- Cylinder ejection should be preponed.

Energy Conservation

- Calcium silicate insulation should be used for the presses.
- For improving reliability of steam traps, strainers should be used on the dome condensate line.
- For improved flushing, an additional half inch line should be provided for the internal drain.

Steps in TPM Implementation

An integral part of any successful implementation project is the active and continuous support of top management. The positive attitude and active involvement of senior management personnel fosters a dynamic, team-oriented environment, which transcends all working levels. The first stage of implementation of TPM is called the preparation stage. Herein one tries to create a suitable environment by establishing a plan for the introduction of TPM. The ten basic steps, which were followed for the implementation of TPM in the manufacturing unit, are as follows:

- Announcing top management's decision to introduce TPM
- Launching of educational campaign
- Creation of an organisation to promote TPM
- Establishment of basic TPM policies and goals
- Formulation of a master plan for TPM development

Preparatory Stage

- Improvement of equipment effectiveness
- Establishment of an autonomous maintenance programme for operators
- Setting up of scheduled maintenance programme for the maintenance department

- Conducting training to improve operation and maintenance skills
- Development of new (initial) equipment management programme.

The formal presentation was made in this case by the Director of the Production Division in a meeting with all employees chaired by the Vice President. During the presentation, the Director of Production Division was assisted by the Director of the Engineering Division. Also in the plant, the task of education and training was taken up seriously by the managers of the maintenance and tyre production departments and the middle management personnel. Educational campaign was launched soon after the introduction announcement. The objective was not only to explain concepts, goals, and benefits of the practice of TPM, but also to raise employee morale and soften their resistance to change. It was found that resistance to TPM came from both equipment operators and maintenance tradesmen. TPM education of workmen included slide presentations and other visual aids. Supervisors and middle management personnel were invited to address sessions in which they explained their expectations and related their experience. TPM training was more specific and it dealt with the specifics of participation and problem-solving in PM groups and circles. The training module used for the supervisors also included group dynamics, facilitation and leadership.

Educational campaign was launched not only to explain concepts, goals, and benefits of the practice of TPM, but also to raise employee morale and soften their resistance to change.

After the completion of the introductory education of the employees at different levels (to create an awareness of TPM) the task of forming an organisational structure for the promotion of TPM was taken up. It became necessary to modify the company's organisational structure to enable integration of the structure used for TPM promotion with the organisational structure of the company. The modification was carried out in two steps, and with the modified structure in place, the organisation structure for TPM promotion was created. The fourth step of implementation was the first major task undertaken by the management. It was recognised that although the policies may be abstract written or verbal statements, the goals should be quantifiable and precise, specifying the *what* (objective/goal), *how much* (the targeted quantity) and *when* (time frame/plan period). For example, a basic management policy may be as follows:

> "To reduce losses by eliminating breakdowns, stoppages, defects and accidents, while enhancing the profitability of the company and creating a favourable work environment for all employees".

In this statement, the objectives of the management are clear, and at the same time, the basic policy can be stated in concrete figures, such as the goals given in quantitative units. However, since the total elimination of breakdowns, stoppages and defects may not be possible, the management must set intermediate goals. At this stage it was decided that the annual goals should be determined by the managers and supervisors, who should, in turn, ensure that the improvement themes and goals set by the small groups at the shop floor workers' level were consistent with the overall goals of the company. Meetings were held to determine the target areas and to set goals.

Since the total elimination of breakdowns, stoppages and defects may not be possible, the management must set intermediate goals.

After the formulation of the basic policy and definition of goals, a master plan for TPM implementation was established. It concentrated on the following five basic activities.

- Improving equipment effectiveness through minimisation of the six major losses. This activity would build the foundation for implementation of autonomous maintenance.
- Establishing an autonomous maintenance programme for equipment operators.
- Ensuring a reasonable level of product quality and concentrating on activities directed at improvement of quality.
- Establishing a schedule for periodic preventive maintenance of equipment to be carried out by the maintenance department.
- Education and training of personnel to improve their knowledge/abilities and skills.

It was also decided that this master plan should be reviewed and revised, if necessary periodically, to ensure that the projects do not fall behind schedule. These

five steps were the preparatory steps and the actual implementation of TPM had yet to start. It had, quite obviously, to begin with the battle against the six major equipment-related losses.

The start of actual implementation was the holding of the TPM 'kickoff' to usher in an atmosphere that increases worker morale and commitment. At the tyre manufacturing factory, the kickoff took the form of a meeting which was attended by all employees and in which the top management gave a report of the plans developed and also the work done during the preparation stage, presented the basic TPM policy and goals, and the master plan for TPM development.

E-2 bag-o-matic press and the curing department had been chosen as the starting points of TPM implementation and accordingly, the sixth step consisted of equipment effectiveness improvement efforts for the E-2 press. Engineering and maintenance personnel, production supervisors and members of PM circles and sub-circles were organised into project teams. Improvement projects had already been identified, and each of these teams concentrated on a few of the identified projects. The efforts of the teams were crowned with unprecedented and unexpected success. Through implementation of the improvement projects, equipment effectiveness of the E-2 press went up from around 60 per cent to more than 90 per cent. During the first week after implementation (during the first seven day period), it went up to 89.5 per cent. There was further improvement in the following week with the effectiveness going up to 96.1 per cent. This impact could be maintained, and thereafter, equipment effectiveness had been kept at a figure above 90 per cent. Details of the performance of E-2 press are given in Tables 5 and 6.

The second basic activity of the master plan was establishing an autonomous maintenance programme for equipment operators. This step was taken up pretty early in the TPM implementation programme because it would take time to change deep-seated attitudes and habits. It was decided that in addition to training in autonomous maintenance skills, equipment operators must start the practice of autonomous maintenance and this, in turn, must start with cleaning of equipment and developing own cleaning and lubrication standards. Based on this, it was decided that the following programme would be adopted for the production line workers initially in the curing department and later in the remaining manufacturing departments:

- Initial cleaning
- Developing countermeasures for the causes and effects of dirt and dust

Table 5: E-2 Press Performance After TPM

Day	Number of tyres cured	Availability	Performance Rate	Quality Rate	Effectiveness (per cent)
Before TPM	30	0.833	0.875	0.833	60.71
1	34	0.854	0.967	0.941	77.70
2	40	1.000	0.972	1.000	97.20
3	36	0.924	0.947	1.000	87.50
4	38	1.000	0.924	1.000	92.40
5	40	1.000	0.972	1.000	97.20
6	12*	1.000	0.875	1.000	87.50
7	38	0.965	0.957	1.000	87.50
8	40	1.000	0.972	1.000	97.20
9	40	1.000	0.972	1.000	97.20
10	40	1.000	0.972	1.000	97.20
11	40	1.000	0.972	1.000	97.20
12	42	1.000	1.021	0.952	97.10
13	12*	1.000	0.875	1.000	87.50
14	42	1.000	1.021	0.976	99.60
15	40	1.000	0.972	1.000	97.20
16	42	1.000	1.021	1.000	102.10
17	12*	1.000	0.875	1.000	87.50
18	40	1.000	0.972	1.000	97.20
1-7	238	0.963	0.944	0.984	89.50
8-14	256	1.000	0.972	0.989	96.10

*Sunday/Holiday

Table 6: E-2 Press Weekly Performance

Week	Number of tyres cured	Availability	Performance Rate	Quality Rate	Effectiveness (per cent)
Before TPM	176	0.801	0.790	0.811	51.32
1	238	0.963	0.944	0.984	89.50
2	256	1.000	0.972	0.989	96.10
3	230	0.997	0.960	1.000	95.71
4	248	0.978	0.972	0.987	93.82
5	222	0.980	0.960	1.000	94.08
6	260	1.000	0.972	0.993	96.51
7	254	0.983	0.953	1.000	93.67

- Developing cleaning and lubricating standards
- General inspection
- Developing inspection standards
- Organisation and tidiness
- Full implementation of autonomous maintenance.

The first three activities were necessary to prevent deterioration and maintain the basic condition of equipment, and the fourth was aimed at detecting and measuring deterioration, if any, through general inspection. Earlier, at the end of the fifth step of implementation of TPM, it had been decided that in addition to maintaining basic conditions and carrying out general inspection of equipment, operators were also to be responsible for the following:

- correct operation and setup (setting conditions and checking product quality)
- detection and treatment of abnormal conditions
- recording data on operation, quality and processing conditions, and
- minor servicing of equipment.

With this, the programme for the production department was finalised.

Development of a scheduled maintenance programme (of jobs to be carried out by the maintenance department) actually began before the setting up of the general inspection procedure by operators. The maintenance department developed equipment standards independently, so that these were available for comparison with the standards set up by operators during the autonomous inspection stage. It was realised that a clear division of the responsibilities of the two departments is the key to thorough inspection and effective equipment inspection can only be accomplished when the two sets of standards are combined. Training is very important and the company must make this investment. Competence of the maintenance personnel is essential for success of the implementation programme, and considerable effort was made for upgrading the 'know-how' of maintenance tradesmen. At the end of this step, operators were also able to operate their equipment safely and as per the set standards, in addition to maintaining basic equipment conditions. Then the TPM Promotion Committee gave its recommendation on the new maintenance policy. These recommendations were as follows:

- Autonomous maintenance – enforcing daily and weekly inspections by equipment operators.
- Improving corrective maintenance techniques through upgradation of skills of maintenance personnel.
- Identification and correction of plant abnormalities which cause low equipment availability, high maintenance costs, or poor quality. Also ensuring feed back of such information to maintenance planning section, and design for plant and equipment modifications and maintainability improvements.

New equipment management is a very difficult task. Problems often show up during test running and start up, and design, process and maintenance engineers may have to make improvements before normal operation can begin. The objectives of new equipment management programme are improving equipment reliability and increasing ease of maintenance. It was decided to work towards these objectives through improvement activities by ensuring the following:

- Proper attention to reliability and maintainability features, safety, and economy of life cycle costs during equipment investment planning and specification development stages of the life cycle.
- Setting up a team for developing equipment specifications, installation plans and commissioning trials. This team should include representatives from design/engineering, process/technical, operations/production and maintenance departments.
- Working with the equipment manufacturer to ensure that the equipment is actually manufactured according to specifications.
- Reducing the time period from acquisition to stable operation by proper execution of installation plans, commissioning trials and debugging.

With the completion of this step, the work of TPM implementation in the curing department had been completed. However, this was just the beginning of the TPM implementation programme, since TPM had yet to be implemented in other departments, for other processes. Moreover, there were still a number of loose ends and therefore, the work of refining and perfecting TPM implementation had to be taken up.

The three case studies discussed are quite different in size, scope and area of application. However, they are complementary in nature, and together help to bring out the salient points about TPM – its need and implementation.

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World Class Manufacturing: A Strategic Business Driver

G.D. Sardana

Globalisation has brought sweeping changes in many areas of business activity. Manufacturing, till recently has been mostly supply driven. Its performance evaluation has been confined to measures such as the productivity of labour, materials and capital, manufacturing cost, capacity utilisation, losses on shopfloor and value addition. Later day models have advocated measurement of system productivity. Manufacturing has hardly focused on issues such as long range capability planning, choice of technology, a culture of manufacturing excellence, innovation plans etc. Competition ushered through globalisation has brought new challenges. Manufacturing has come to be recognised as a strategic business driver. There is a movement to meet the challenge by adopting and deploying world class best practices in manufacturing activity. There is a need to carry out benchmarking and global standards. This paper examines the role of manufacturing and evaluation of its performance in a historical perspective. It also brings out the characteristics of world class manufacturing in various sub-systems. An approach has been suggested to evaluate the readiness status for world class manufacturing (WCM) in an organisation.

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WTO agenda has created many serious imperatives for trade and industry in general and manufacturing in particular. The rules of multilateral trade, intellectual property rights, policies, regulations and laws related to environment, labour standards, good governance and product quality standards as applicable to industrialized world are to be applicable to developing economies as well, in a defined frame work of time. It has ushered in an era of globalisation where the competition is worldwide and survival is based on capability to meet the marketing challenge. The revolution taking place in diverse fields such as IT, bio-technologies, communication, medical sciences, new materials etc. has only strengthened the process of globalisation. The changed economic environment has come to stay. The concerns, apprehensions and fears of the new order have to be addressed. There are no alternatives except to re-organize, re-structure and prepare to compete in world markets. It calls for meeting world competition, both in domestic and international markets.

Global competition requires a world class performance. It requires development of ability and competence in a number of areas. Manufacturing and manufacturing infrastructure constitute a basic requirement to build a strong economic foundation. Many economists opine that generation of wealth is through value addition, an essential component of manufacturing. It is therefore, essential that the manufacturing system is strengthened; the competence and capabilities are enhanced; technology is upgraded on a continuous basis and performance brought to a level to meet the challenges of highly dynamic environment of global competition. World Class Manufacturing (WCM) is to be understood and appreciated in this context.

WCM encompasses several facets. It calls for availability of world class technology, the capabilities to respond quickly, efficiently and effectively to desired changes in demand, commitment to customer focus, product and process quality and a vision to reach

reduced process cycles, reduced cost of production and flexibility of operations.

Manufacturing: A Historical Perspective

Beginning of the organized effort

Man over generations has endeavoured to carry out different tasks by harnessing human skills and developing appropriate tools. However, the first of the organized efforts to establish manufacturing as a functional activity can be traced to decade 1760-1770, which brought contributions of James Watt and ushered in industrial revolution. The manufacturing practices centered around the deployment of skills of workman on appropriate jobs. Both quantity and quality of production came to depend on the skills of the labour. Production measured in physical units came to be accepted as the major measure of manufacturing. What came to be produced had a ready market. As more and more industrial units came up to produce the same or similar products, an element of competition got introduced. The manufacturing performance came to be evaluated in terms of efficiency.

Production measured in physical units came to be accepted as the major measure of manufacturing.

Days of Scientific Management

The turn of the 20th century saw the advent of 'Scientific Management'. F.W. Taylor differentiated the role of the manager and the workman. He advocated that management should take responsibility in planning, direction and organizing work and labour to carry out assigned tasks. Thus it came to be recognized that managerial capabilities had an important role to play in the process of production. Scientific management also brought in improved process quality and hence better quality products with consistency in performance. Assembly lines helped the quality dimension as these called for use of interchangeable parts. Assembly line products on account of consistency enjoyed an edge over others. Scientific methods of production and a motivated workforce increased efficiency and brought down cost of production. Element of cost emerged as another factor of competition.

Age of Mechanisation

The two world wars brought radical changes in manufacturing practices. Optimisation of production and optimum use of resources became the strategic policies. A new multi-disciplinary approach, known as Operations Research was born. This emphasized the development and applications of mathematical models as linear programming queuing theory, forecasting techniques, Monte Carlo simulation methods etc. Machine tools were redesigned with increased work parameters as well as with multiwork stations permitting use of one workman over multi machine systems. Alongside labour, the importance of machines and materials also came to be recognised. Evaluation of manufacturing also changed. The measures got enlarged. New measures included output from labour, yield from materials and efficiency of machines. Process rejections on the shop floor, wastage of materials, machine utilization, machine downtime also came to be considered. Value added per man hour and value added per unit of material became other criteria.

Era of Mass Scale Production

End of the second world war ushered in newer manufacturing concepts of faster assembly lines and high speed tools suitable for large scale/mass production. Mass production technology was also responsible for introducing consumer goods. Optimum utilisation of hard assets, that is inventory, plant & machinery, buildings, land became important criteria. Material planning and inventory control came to be recognized as full disciplines.

Age of Automation

Late 1970's ushered in an age of automation. Consumer products had created a new market segment and a new class of customers. Factors that influenced production included product and process technology, ability to innovate, a high emphasis on quality and a controlled cost of production.

Contemporary Manufacturing

The current scenario is changing rapidly. Global competitive equations and multi-faceted constraints are propelling manufacturing in several directions. Revolution in IT and telecommunications witnessed in the last decade, a high customer expectation of responsiveness, service and satisfaction, availability of a wide choice of branded and unbranded products, short product cycle, reduced lead time from concept to materialisation of the product, quality and costs have necessitated reinventing manufacturing. New trends have emerged in the manufacturing technology encompassing both products and processes. Manufacturing management is expected to compete globally for the

survival of the corporation. Global competition implies that the manufacturing must reach world class performance. It should develop characteristics which successful manufacturing strategies possess and are termed as world class manufacturing. WCM does not therefore imply competition only in foreign markets but is equally valid for domestic markets also.

Characteristics of World Class Manufacturing

WCM has been discussed by several authors and its characteristics brought out in detail. Deshmukh and Dangayach (1998) have highlighted strategy as its main characteristic covering areas of planning, role of manufacturing, development of human resources and communication. Other characteristics include:

- Long range orientation
- Stress on continuous improvement
- Supplier-customer integration.

Sahay and Saxena (1999) have also emphasised the importance and relevance of WCM to the industry in developing economies now exposed to the uncertain environment of global competition and quote Kinni that WCM is characterised by three core strategies of customer focus, quality and agility and six supporting competencies of employee involvement, supply management technology, product development, environment responsibility and employee safety and corporate citizenship. It is proposed to study WCM characterised in sub-systems of:

- Manufacturing Strategy
- Manufacturing Technology
- Manufacturing Management Practices
- Human Resource Management

Manufacturing Strategy

Manufacturing strategy has been generally defined as a series of sequential decisions that concern with setting of broad policies and plans of acquisition and deployment of resources to achieve desired manufacturing objectives. These objectives relate to manufacturing structure, infrastructure, establishment of capabilities and plans to win competitive advantage in the long term. Manufacturing strategy is to establish guidelines and policies for various functional areas so as to utilize the manufacturing strengths most effectively for achieving corporate objectives. A clear manufacturing strategy can be examined under several Key Performance Areas (KPA's), the prominent ones are, as follows:

Table 1: Sub-systems and KPA's for World Class Status

Sub-Systems	Key Performance Areas
Manufacturing strategy	Alignment with business objectives Long range focus Focus on customers Focus on flexibility Supply Chain Strategy
Manufacturing Technology	Alignment with Products High work parameters Automation Reliability Focus on IT
Manufacturing Management Practices	Materials management practices Quality practices Productivity practices Performance Measurement practices Maintenance practices
Human Resource Management	Organisation Development HRD Employee welfare practices Environment protection practices Customer service orientation

Manufacturing strategy is to establish guidelines and policies for various functional areas so as to utilize the manufacturing strengths most effectively for achieving corporate objectives.

Alignment with Business Objectives

Business objectives generally are concerned with competitive dimensions of market. Not much attention is paid to the manufacturing; it is presumed that it will adjust and deliver the goods. However, in a highly competitive and turbulent environment it is necessary to align the manufacturing capabilities with business strategy. High volume and requirements of flexibility (to go for product variations at short notice) call for different manufacturing systems. One calls for automation and facilities for mass production, the other for adoption of agile manufacturing. The process of proper alignment calls for identification of winning criteria or priorities that will win against competition. Change of business objectives can necessitate new investment in plant and machinery and installation of new technology.

Long range Focus

Often manufacturing plants have been set up to reap harvests of short term or 'friendly' interests. Plants have been setup to obtain calculated subsidies as offered by the state in the form of concessions on sales tax, energy, land prices, infrastructure, export incentive,

low interest loans etc. Most of these units would remain oblivious to competition and die a natural death once the concessions vanished. Similarly, many units come up as a result of commitment from friends and relatives to provide orders or considerations of "I help you—you help me". These business organisations tend to wind up once the cover goes. WCM calls for a commitment and a policy strategy to build up the strength of manufacturing. Strategic planning is always for long range orientation. It requires time, energy and financial resources to adopt and implement best practices.

Strategic planning is always for long range orientation. It requires time, energy and financial resources to adopt and implement best practices.

Focus on Customer

In a customer focussed manufacturing strategy, customer satisfaction is the prime objective in several dimensions. Customer decides the acceptable levels of quality, the right price of product, the right delivery schedule and the right degree of responsiveness. In other words, the wants and priorities of a customer require to be integrated with manufacturing. Traditionally, the selling price of a product is built up from the cost of production. However in a customer-focussed setup, the manufacturing cost is arrived at from the price a customer is willing to pay. In similar context the quality of a product is built up in stages of design and manufacturing by taking into account the expectation of the customers as against delivering the quality based on decisions of design and processing.

Focus on Flexibility

It has been generally agreed that customer focus will increase in coming years. A faster progress in technology is expected, leading to changes in product design, quality parameters, use of newer materials and customer expectations. Manufacturing strategy has to take these considerations into account for survival. Flexibility is represented in several dimensions. It amounts to faster response to start processing when customer orders are received. It also means arrangements to lead to quick change to accommodate product mix and its variety, capability to manage small volumes, short lead times and fast tool set ups. One pre- requisite for these requirements lies in ability to collect information and process the same in time. With world wide operations, a company may have to depend heavily on IT.

Supply Chain Strategy

Sahay and Jain (2000) point out that the role of supply chain has changed considerably. It is not merely the integration of warehousing and transportation functions within the organisation. It is now an expanded broad concept beyond the boundaries of the organisation. Cavale and Rajani (2000) quote The Council of Logistics Management and define supply chain management as 'the process of planning, implementing and controlling efficient and cost effective flow of raw materials, in-process inventory, finished goods and related information from point of origin to point of consumption for the purpose of conforming to customer requirements'. In brief, its scope extends from the concept of the product, procurement of materials, development and providing to customers. It is an important link and forms an interface with manufacturing on one side and suppliers, transporters and consumers on the other. The suppliers and the consumers may be located at different places. It calls for co-ordination and active integration of people, facilities, movement of materials, systems and controls to obtain the best results in terms of minimised costs, response, time and schedules of delivery.

An effective supply chain strategy calls for determining numbers, location and role of each partner of the supply chain. Financial commitments are required for facilities at the suppliers/vendors as well as with the transporters. A close interaction, collaboration and co-ordination is required between the partners very often on long term basis. It requires synchronisation with manufacturing.

An effective supply chain strategy calls for determining numbers, location and role of each partner of the supply chain.

In supply chain system, supplier can be a vendor as well. A vendor manufactures parts for the principals on exclusive basis. Most of the time, the design and the know how are loaned to the vendor. In large setups, especially in assembly line production, vendor development becomes a major task. Vendor development requires mutual trust. For a long term relationship the two parties should agree on vital areas such as business ethics, development framework, quality standards, process controls, improvement programmes and even business commitments. These are once again strategic decisions.

Manufacturing Technology

If one single sub-system were to be singled out to project the true status of manufacturing, it could be only technology. Product quality, cost, delivery schedules, are often determined by the choice of technology. Besides, a host of other benefits can be derived or enlarged from technology. And these include reduction in inventories, reduced cycle time, better yield from materials, reduction in tool setup times, high worker productivity, reduction in process rejections, introduction of new product models at faster rate, reduction in paper work, high capacity utilisation, reduction in manufacturing lead time etc. Manufacturing technology is a vast field. This section covers what many refer to as hardware technology. Best practices of manufacturing technology in world class setup can be assessed in the following key areas:

Alignment with Products

Choice of technology is closely related to products to be manufactured. The characteristics of the products in terms of materials used, dimensions, tolerances and consistencies required determine the type of plant and machinery. Another important dimension is the scale of production. Large batch size or mass scale production requires automation. Small batch sizes or frequent changes in schedule may require flexible manufacturing systems. The plant should be adaptable to accommodate variety. In fact responsiveness and flexibility are two of the most important pre-requisites to sustain competitiveness. The technology should therefore be in a position to cater to deliver a variety of models with least disruption in manufacturing system. Cost of production, another important dimension, is also related to the choice of technology and scale of production.

Responsiveness and flexibility are two of the most important pre-requisites to sustain competitiveness.

High work parameters

High speeds and other operating parameters have been the major thrust areas of new developments in machine tools. New innovations have been introduced and machine configurations redesigned for a lower set-up time, higher flexibility, fast and accurate system with minimised idle time between the productive cycles. Apparently these have also led to reduced process rejections, higher output per machine hour and lower costs per unit of output. An organisation aiming at WCM has to be constantly on the look out for machine/plants with high work parameters and necessary tools for the same. High speed/work parameters will also call for retraining of operators.

Automation

In addition to high work parameters, automation adopts techniques which are less dependent on the skills of an operator either to operate the plant or to obtain higher accuracy or precision. With introduction of CNC systems, AC servomotors, linear transducers, fast and accurate sensing devices and CAD/CAM programming aids it has been possible to achieve the twin objectives. Examples of another dimension of automation include transfer lines, robotics, SPM's, machining centers, high speed assembly lines with built-in control systems, computerised controls etc.

Reliability

The process technology should have built–in provisions of a high operative time with minimum possible breakdowns in between. In a reliable plant or machine, the meantime between failure should be higher than the gap between two preventive maintenance schedules. In other words, more the availability of a machine without breakdown, higher is the reliability. Another dimension of reliability of the technology is reflected in delivering the design capability. Longer the period over which the plant continues to ensure precision, close tolerances and consistency as designed, more reliable is the technology. Process capability of the plant has to match the design parameters of the products in terms of accuracy, tolerances. The process capability should exist to generate the accuracy within controls and ensure repeatability cycle after cycle. This calls for full knowledge about the process capability of the technology before it is chosen for a product. In WCM set-ups, it is expected that the process technology capability should match the best standards of reliability.

In WCM set-ups, the process technology capability should match the best standards of reliability.

Focus on IT

Tewari (1998) points out that the onset of NC and the information technology revolution has brought

faster, reliable, powerful and yet economical control systems to manufacturing automation. There is an imperative need to integrate knowledge from several fields to take care of fluctuations in demand and resources. IT has come to play a very significant role in this process of integration, which in brief represents the extent to which transfer of data is achieved electronically. Application and extent of computersation has already covered areas such as stores, inventory controls, salary administration, purchasing and vendor development, quality control systems and MIS.

WCM relies heavily on data and information for its decision making. The information so collected is not the end in itself. IT requires to be sorted out, correlated and co-ordinated. The end result is in the form of smooth workflow, co-ordinated schedules, faster distribution, reduced costs, control in inventories and eventually higher customer satisfaction. IT provides means for better responsiveness. Sahay and Saxena (1999) have even recommended to consider IT as a strategy. Manufacturing strategy and IT strategy are to be aligned to derive full competitive advantage. The importance of IT as a component of modern manufacturing technology cannot be ignored.

Manufacturing strategy and IT strategy are to be aligned to derive full competitive advantage.

Manufacturing Management Practices

Besides technology, there are several tools in the hands of manufacturing managers which are helpful to improve the quality of manufacturing operations. These have been also referred to as best practices or new manufacturing technologies and have been widely practiced worldwide to bring in a higher value addition, better performance and higher productivity. There are large number of practices available: these can be grouped under classifications of the following KPA's. It is not necessary that an organisation aiming at WCM has to adopt all these practices. A company has to choose practices suiting its requirements.

Materials management practices

As percentage of the total cost production, materials constitute highest share. Therefore, materials also present a high opportunity area to work for cost reduction. One of the approaches lies in generation of savings through control of inventories and storage costs. Inventory management and control has developed into a major discipline. Other areas in materials related management include waste reduction, substituting with new less costly materials etc. Some of the prominent management practices include: JIT, KANBAN, BPR, Value Engineering, Waste Elimination, Inventory Control, Standardisation, Vendor Rating etc.

Quality practices

The concept of quality itself is now broad based and covers the entire chain of processes in the supply chain such as product design, material procurement, vendorisation, processing, distribution and logistics. Elementary Quality Statistical Methods (seven tools: Pareto Chart, Cause and Effect Diagram, Process Flow Chart, Check sheet, Histogram, Scatter Diagram, Control Charts); Intermediate Statistical Methods (Theory of Sampling Survey, Statistical Sampling Inspection, Sensory Tests, Method of design Experiments), Multivariate Analysis, TQ, TQM, Quality Function Deployment, ISO-9000 Certification, Customer Satisfaction Measurement are some of the well known practices followed.

Productivity related practices

Productivity is a broad term and encompasses large areas in manufacturing. New manufacturing hardware and software technologies have been developed to bring about improvement. Organisations have implemented these practices and derived benefits in areas, as mentioned by Korgaonker (1999), like worker productivity, product quality, product support, after sales service, wider product lines, introduction of new models, low inventories, reduced cycle time, zero defects, sourcing, yield etc. Besides, other intangible benefits include reduced paper work, information system, quality of work life, functional and cross functional team work etc. A large number of ever expanding technologies exist and these include:

- Agile Manufacturing, Cellulor Manufacturing Systems, OPT, BPR, Lean Production, Concurrent Engineering, Benchmarking, Virtual Manufacturing System.
- CAD, CAM, LAN/WAN, CIM
- JIT, MRP I, MRP II, ERP
- Industrial Engineering techniques, Production planning, Work norms, Process improvement.

Companies have to choose the technology best suited to their needs, Kargaonker (1999) mentions that these tend to be used in clusters as CAD/CAM/CIM and JIT, MRP-I, MRP-II, ERP, etc.

Performance Measurement practices

Measurement provides not only status of performance but it identifies gap between the target and the actual achievement. Measurement thus emerges as an important tool for improvement of operations. It can be said that there cannot be improvement without measurement. It is therefore necessary that an elaborate system of measurement of performance is introduced and implemented whereby performance at each stage of operation can be measured quantitatively. TPM refers to these as PQCDSM parameters: Productivity, Quality, Cost of inputs, Deliveries (to customers), Safety and Morale. Others have laid stress on cost as the major parameter.

Control on cost is fundamental to competitive market environment. It is necessary to have a fast and reliable feedback on costs, expenses incurred and budgetary provisions. In a dynamic environment, information in these areas helps to draw up new strategies in the market. Delayed information on the other hand can lead to disastrous results on account of failure to initiate corrective steps. Some of the important practices in cost control include: Activity based costing, cost benefit analysis, zero based budgeting, cost control, Inter firm comparison, cost productivity. Sardana (1987) has advanced an integrated multifaceted approach to productivity measurement as PO–P model, which considers productivity as the representative of total performance of a system (or sub-system).

Important practices in cost control include: activity based costing, cost benefit analysis, zero based budgeting.

Maintenance practices

As automation provisions increase in the plant and machines, the equipment becomes more complex. The machines require trained and skilled manpower to diagnose the faults. Cost considerations require that the failures and the non-operational time should be reduced to bare minimum. Besides, the machinery require regular checks and preventive maintenance to reduce down time and maintain precision. Best practices include TPM, Preventive Maintenance, Planned Maintenance etc. Total Production Maintenance (TPM) has been advanced as a unique way of building or re-building a manufacturing plan. It is considered as indispensable strategy for world class companies. TPM is based on zero loss concept of zero breakdown, quick changeovers, zero speed losses and zero defects and lays stress on planning, co-ordinating and monitoring the activities and results.

Human Resource Management

Even the best of information technology and control systems will be ultimately dependent on human resource for optimum utilization of the potential. An organisation requires not only intelligent work force, knowledgeable and skilled in tasks but capable of working as a team. A conducive organisation culture encourages collective participation and motivation, loyalty and commitment towards organisation. Participation and involvement of employees helps growth. Organisation culture is generated and sustained through a number of measures initiated by top management. It calls for a proper organisation structure, a transparent policy and a system which encourages excellence and rewards performance. The following KPA's are highly relevant.

Organisation Development (OD)

Kieth C. D'Souza and Kuldeep Singh (1998) point out that OD is a behavioural science based approach to organisational improvement and has a focus on aspects that have a bearing on social and human improvement. It implies deliberate intervention in this ongoing process. Behavioural scientists have developed many types of interventions. Other practices include: Organisation Restructuring, Training Needs Assessment, Participative Group Activities etc.

HRD

Employees require training and exposure to several areas. The company requires to inculcate amongst employees values of interdependence, inter-personal relationship, positive approach, ethics and spirit of superlative achievement. Employees require encouragement to develop their own goals, needs and aspirations linked to the corporate goals so that they work wholeheartedly towards the fulfilment of objectives. A number of practices have been developed towards these goals. Some of the important tools include:- Brainstorming, Force Field Analysis, Quality Circles, Job Rotation, Job Enlargement, Job Enrichment, Conflict Management, Incentive Schemes, Suggestion Schemes, Gain-sharing Schemes, Career Planning and Progression, Job Evaluation, Manpower Planning/Assessment.

Employee Welfare Practices

For retention of expertise, skills and knowledge, the organisation requires vigilance towards prevalent structure of salaries, wages, and the needs of its employees in areas as security, growth, welfare and work practices. Best practices in these areas have to be explored and

adopted. Building up a rich foundation of skills and motivation is the necessity.

Environment Protection

A world class organisation helps in protecting environment beyond its frontiers, builds public opinion against pollution, takes up issues related to societal cause and welfare of people. Products offered to the consumers are expected to be safe in operations, hazard free and biodegradable whenever possible.

A world class organisation helps in protecting environment beyond its frontiers.

Customer service orientation

Manufacturing is required to imbibe a service orientation that all employees work for customer satisfaction, customer's perceptions of quality, cost and the product performance. The manufacturing system in totality has to orient itself from the stages of planning to the completion of end product, to serve the customer in the best possible means. Customer preferences should become guidelines to carry out the process.

An Index of Readiness for WCM

Building a world class manufacturing organisation has both challenges and opportunities. The initial challenge lies in identification of a manufacturer which has excelled in business at international levels and has come to be accepted as a leader in areas such as accelerated growth, quality of its products, responsiveness to the needs of customers, innovative approaches and excellence in performance. It is not easy to fix the benchmarks. An organisation has to analyse its own strengths and weaknesses and thereafter fix the benchmarks for achievement in stages.

Building a world class manufacturing organisation has both challenges and opportunities.

The various sub-systems and the KPA's which have been considered as critical areas for WCM have been tabulated in Table1. Each of the KPA's has to be evaluated on a five point comparison scale against the benchmarks (benchmarking can be against internal yard-stick as well). Score of 1 indicates 'unpreparedness' and a score of 5 indicates 'well preparedness' against the benchmark, with scores of 2, 3, 4 showing degrees of preparedness in ascending order. The rating score can be aggregated up against each sub-system. Aggregate of the scores of the sub-systems provides an Index of Readiness for WCM. Weightage factors can be assigned to sub-systems and the KPA's in case these are not considered equal in ranks. These have been explained in detail by Prem Vrat et al (1996). Assuming that all sub-systems are equal in ranks and all the KPA's are also equal in each of the sub-systems, this will generate a maximum and minimum score of 100 and 20 respectively.

- A score of 90 and above projects well preparedness.
- A score of 60-90 is a good score and projects good efforts to reach world class.
- A score below 60 calls for in-depth analysis to identify areas for improvement.

Conclusions

Strategies, objectives and the measures of performance differ in organisations which aim at world class. Building a world class manufacturing organisation is a strategic decision. It involves investments, adoption of best practices in several areas of operations and preparing employees for superlative performance against global competition. In traditional manufacturing systems, there is a strong emphasis on achievement of high productivity of labour, capital and materials. Maximisation of capacity utilisation has been another major objective. Manufacturing has been considered a passive function subservient to marketing strategy. Very often manufacturing has had only short term goals. WCM calls for the manufacturing strategy to be fully aligned with business objectives and the marketing strategy. WCM has been examined under four sub-systems: Manufacturing Strategy, Manufacturing Technology, Manufacturing Management Practices and HR Management. Each of the sub-systems is considered to comprise of five key performance areas which should be assessed against benchmarks. A methodology for arriving at an Index has been proposed which provides a ready measure to evaluate an organisation.

Building a world class manufacturing organisation is a strategic decision.

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MANAGEMENT THOUGHTS : BY PRAMOD BATRA

Excellence in Action in a Dealership is when Employees:

1. Pay attention to details
2. Do things right the first time
3. Practice good human relations

□ Think Inc., Batra

Feature

The Balanced Scorecard: A Critical Review

Hemant Kumar Sabat

The Balanced Scorecard (BS) is a comprehensive framework that translates a firm's strategic objectives into a coherent set of performance goals. The scorecard has emerged as the remedy to the limitations of measuring only short-term financial results. This paper presents a critique of the scorecard as a strategic management system. Further, it illustrates application of these principles in the development of balanced scorecard at Marketing and Refining (M&R) Division of a Fortune 25 oil company.

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The Balanced Scorecard (BS) is a management system to motivate breakthrough competitive performance through improvements in such critical areas as product, process, customer, and market development. The scorecard presents managers with four different perspectives from which to choose measures. It complements traditional financial indicators (that tell the results of actions already taken) with measures of operational performance for customers, internal business processes, and innovation and improvement—operational measures that are the drivers of future financial performance (Kaplan & Norton, 1992). The downside is, a scorecard being specific to an organisation, there is a premium set on its development and implementation because each organisation is unique.

The BS is a management system to motivate breakthrough competitive performance through improvements in product, process, customer, and market development.

Implementation of BS

BS has helped Rockwater, a wholly owned subsidiary of Brown & Root/Halliburton, a global engineering and construction company, to emphasize a process view of operations, motivate its employees, and incorporate client feedback into its operations (Fig. 1). It developed a consensus on the necessity of creating partnerships with key customers, the importance of order-to-magnitude reductions in safety-related incidents, and the need for improvement management at every phase of multi-layer projects (Kaplan & Norton, 1993). Apple Computer developed a BS to focus senior management on a strategy that would expand discussions beyond gross margin, return on equity, and market share. Once a technology-and product-focused company, Apple has intro-

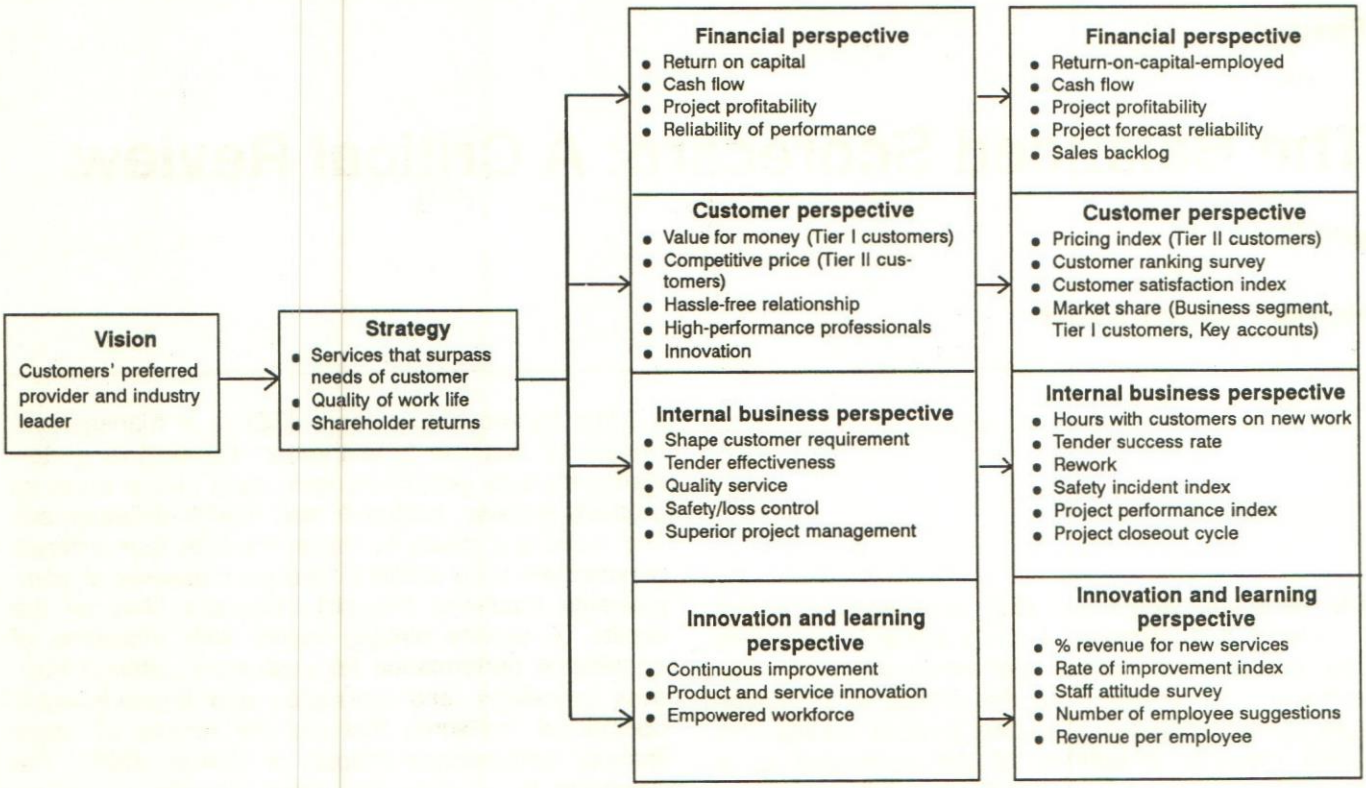

Fig. 1. Rockwater's Balanced Scorecard

duced measures that shift the emphasis toward customers. The metrics are driven both horizontally and vertically into each functional organisation. Considered vertically, each individual measure can be broken down into its component parts in order to evaluate how each part contributes to the functioning of the whole. Considered horizontally, the measures can identify how design and manufacturing contribute to an area such as customer satisfaction. BS has helped develop a language of measurable outputs for how to launch and leverage programs. It serves as a planning device, instead of a control device (Kaplan & Norton, 1993). At advanced Micro Devices, BS consolidated and focused its diverse measures into a quarterly briefing book that contained seven sections. It is a systematic repository for strategic information that facilitates long-term trend analysis for planning and performance evaluation (Kaplan & Norton, 1993).

BS has helped develop a language of measurable outputs for launch and leverage programs. It serves as a planning (instead of a control) device.

Traditional Measures versus BS

While traditional financial measures rely on control, the scorecard is centered around the vision of the company. Traditional measures work bottom-up and are derived from ad hoc processes. The scorecard's measures are grounded in an organisation's strategic objectives. The scorecard helps focus this strategic vision. While traditional financial measures do not provide a continuity to analyze past performance in order to design the future, the scorecard does so. By evaluating performance from multiple perspectives, the scorecard allows managers to balance multiple stakeholders' interests. It helps managers understand many interrelationships in business decision-making. In sum, the scorecard measures implemented in its entirely is a strategic management system. Traditional measures form a subset of this overarching system (Kaplan & Norton, 1996a & b). Table 1 gives a decision matrix of various factors that compare traditional measuring systems with the scorecard.

Critical perspectives to the use of BS

There are certain approaches to, limitations of and requirements for development and use of the BS as a

Table 1: Traditional measures versus the Balanced Scorecard

Factors	Traditional measures	The Balanced Scorecard (BS)
Origin	Sprung from the finance function	Sprung from the necessity to track the key elements of company's strategy
Source	Bottom-up measures; derived from ad hoc processes	Measures are grounded in an organisation's strategic objectives and competitive demands
Applicability	Universally without significant customizations	Strategic Business Units (SBUs) must devise customized scorecards to fit their mission, strategy, technology and culture
		BS is appropriate for a business unit that has its own customers, distribution channels, production facilities, and financial performance measures
Time horizon	Short-term indicators of performance	Functions as the cornerstone of a company's current and future success
	Report on the results of actions already taken	Reports on drivers of future financial performance
Basis	Control is at the center of these metrics	Strategy and vision form the basis of the metrics
Internal versus external	Focus on internal measures only	Four perspectives provide the balance between external measures (like operating income) and internal measures (like product development)
		Reveals the trade-offs that managers made among performance measures
		Encourages managers to achieve their goals in the future without making trade-offs among key success factors
Focus	Stresses performance for each functional department	Emphasizes measures that integrate key business processes
Consistency	Functions with no regard to other initiatives in the firm	Consistent with the initiatives under way (cross-functional integration, customer-supplier partnerships, global scale, continuous improvement, team accountability)
Critical test	Quantitative soundness	Quantitative soundness
		Relevance to competitive strategic objectives
		Transparent enough to portray business unit's competitive strategy
		Combines management systems in a business unit
Value-addition	Backward-looking	Provides a sense of integration to implement local improvement programs (Business Process Reengineering,Total Quality Management, Employee empowerment, etc.)
	Inability to reflect contemporary value-creating actions	Benchmark against which all new projects and business can be evaluated
		Translates strategic objectives into tangible goals and actions
		Helps managers understand interrelationships between the four perspectives of measurement; helps make informed decisions regarding business problems and growth opportunities
		Serves as the focal point for the organisation's efforts,defining and communicating priorities to managers,employees,customers
		Communicates the importance of building relationships with customers
		Single source of management reporting tying many of the seemingly disparate elements of the company's competitive agenda; minimizes information overload
		Guards against sub-optimization by forcing managers to consider all the important operational and financial measures together emphasizing the trade-offs
		BS is most successful when it is used to drive the process of change (find the focus, achieve consensus between divisions on high priority areas,provide a shared understanding of goals,become market-oriented
		Synergy achieved between the roles of corporate development section and the controller's office
Examples	Profitability, growth, shareholder value	Customer retention,customer impression, employee behavior

strategic management system to achieve its objectives in a company. Based on literature review, and analysis of the implementation process at companies (Rockwater, Sears, Analog Devices, Apple Computers, Advanced Micro Devices, and FMC Corporation), some of these are as follows.

Requirements

BS is appropriate for a business unit that has its own customers, distribution channels, production facilities, and financial performance measures. In short, a BS should be developed only for an SBU.

BS is appropriate for a business unit that has its own customers, distribution channels, production facilities, and financial performance measures.

An SBU needs general managers of profit-oriented businesses. This criterion is the key to success of implementation of the scorecard.

BS requires an extensive, and responsive executive information system to track key elements of company's strategy; such a system links top-level business unit metrics down through shop-floor and site-specific operational measures. Simultaneous implementation of improvements in information systems will enhance effectiveness of BS. Specifically, there is a need for knowledge management initiative to accumulate learning/feedback, best practices, etc. Also, the knowledge base should be accessible through the company's Intranet to all employees. This system will help in educating, disseminating and communicating initiatives and results.

Since BS has an integrated focus, exploring the complex dynamics will likely require simulation and cost modeling. The aim is to make explicit linkages between operations and finance.

Managers recognize the impact that measures have on performance. But they do not think of measurement as an essential part of their strategy. Even while introducing new strategies and innovative operating processes intended to achieve breakthrough performance, companies use the same short-term traditional financial indicators of performance, which may not be relevant to the new goals. The challenge is to cultivate a culture that incorporates the comprehensive business outlook asked by BS. Managers can be updated on how other companies have benefited from implementation of BS through specific examples drawn from the industry.

BS metrics needs to be revisited at periodical intervals as part of the strategic planning, goal setting, and resource allocation processes. This requires that the senior executive team give time and resources.

Each organisation is unique and so needs to follow its own path for building a BS. Though a generic systematic development plan to create BS has been developed, creation of division-specific BS demands significant customization efforts. BS development teams should develop a thorough understanding of the business, industry and unit strategy.

Divisional managers resist the development and implementation of BS because the heightened visibility and transparency of the scorecard takes away the internal trade-offs they had gained experience in making. They should be communicated the benefits of BS through learning maps, dialogue and action plans.

BS should be used to consolidate and focus its diverse measures into a quarterly briefing book containing various sections. It should become a systematic repository for strategic information that facilitates long-term trend analysis for planning and performance evaluation.

To overcome stiff organisational resistance, a two-pronged strategy is required. One, to gain consensus, communicate the benefits of implementation of the scorecard and opportunity costs of not implementing it. Two, to provide incentive to own the system, link BS measures to the employee compensation system.

To overcome stiff organisational resistance, it is required to gain consensus, communicate the benefits of implementation of the scorecard and to link BS measures to employee compensation system.

Senior executives must propagate the idea to other divisions of the company.

Since the process is a dynamic one, the feedback and learning stage can be realized through various levels of indicators.

- Base level reporting (performance data for each measure, historical results against targets, and multiple reporting views).

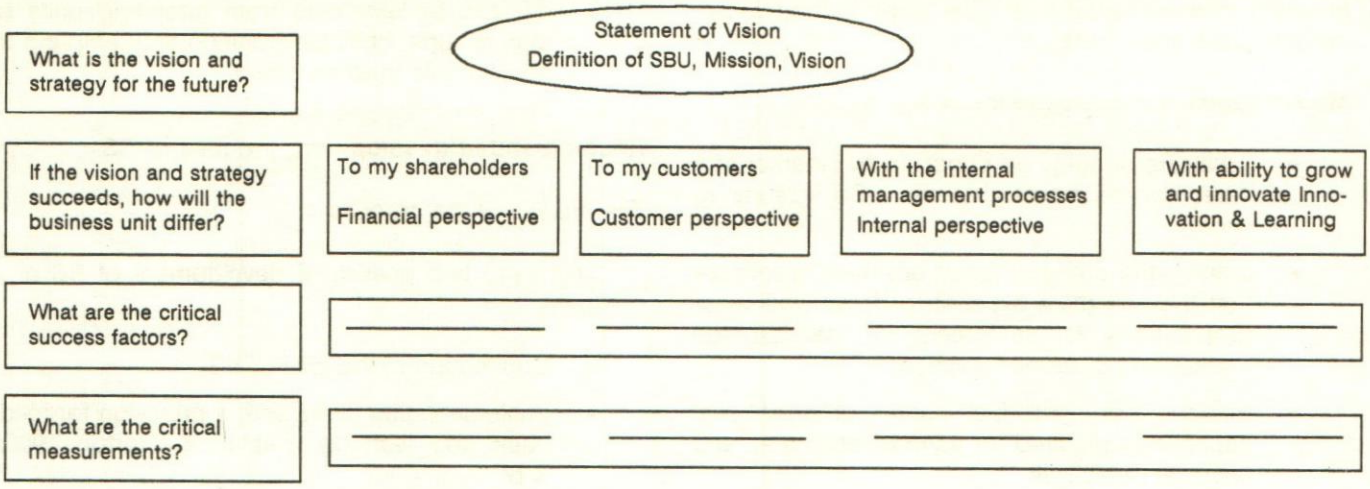

Fig. 2. Linking measurements to strategy

- Visual status indicators (visual representation of measures and relative changes through graphs, charts, different colors)
- Subjective assessment (qualitative explanation and analysis of performance and appropriate action steps)

Review meetings, learning maps and seminars can be held for the purpose.

The four perspectives do not constrain the number of measures that are to be used to assess business performance. If needed, the division may add more measures to obtain a comprehensive measure of performance.

Limitations

BS builds upon its capabilities as a strategic measurement system. However, it is not a measure of a company's strategy. It is bound by the strategy and vision of the company (Fig. 2). Consequently, it measures the key elements of strategy, even if the strategy itself is flawed. This means there is a premium set on the development of an appropriate organisational strategy that is in tune with its environmental changes.

BS does not translate easily to the investment community. Certain precautions are necessary in this regard to avoid pitfalls.

- A BS is primarily for a business unit with a well-defined strategy. Most companies have several divisions, each with its own mission and strategy, whose scorecards cannot be aggregated into an overall corporate scorecard.
- The measures in a BS might reflect highly sensitive data that could reveal much of value to competitors.

(As a relatively recent innovation, BS would benefit from several years of experimentation within companies before it becomes a systematic part of reporting external constituencies.)

- At present financial community shows little interest in making the change from financial to strategic reporting (long-term indicators).

(In recent times, the investment community has begun to focus on some key metrics of new product performance.)

BS is not an impetus for change, especially if the company operates in a single market segment, if its managers are intimately familiar with the markets, engineering, technology, and other key levers in this segment. BS would only encapsulate knowledge that managers have already learned. However, it still serves as a planning device.

BS is not an impetus for change, especially if the company operates in a single market segment.

Approaches to Developing BS

BS is primarily a mechanism for strategy implementation and monitoring, not for strategy formulation. The scorecard can accommodate two approaches for formulating business-unit strategy – starting from the customer perspective or starting from excellent internal

business process capabilities. The steps in the two approaches are enumerated.

Market segment & customer-focus approach

- Articulate strategy as choosing the market and customer segments that the SBU intends to serve
- Identify the critical internal business processes that the unit must excel at to deliver the value propositions to customers in the targeted market and customer segments.
- Select the individual and organisational capabilities required for internal, customer, and financial objectives

Core competence approach

This approach states that companies compete by exploiting unique capabilities, resources, and core competencies (Prahalad, & Hamel, 1993; Hayes, 1985; Collis & Montgomery, 1995). To build BS using this approach:

- Identify critical competencies and capabilities for the Internal Business Process Perspective
- Identify objectives and measures for the Customer Perspective
- Select customer and market segments where these competencies are most effectively deployed

Companies compete by exploiting unique capabilities, resources, and core competencies.

Future Applications of BS

BS can be explored to create value in many ways:

- Translate the BS into operational measures that become the focus for improvement activities in local units
- Link compensation of senior executives to achieving stretch targets for BS' measures
- Integrate the scorecard metrics with hoshin planning, a procedure that concentrates an entire company on achieving one or two key objectives each year. Analog Devices is attempting to achieve this (Kaplan & Norton, 1993).
- BS can be extended from operating units to staff groups. FMC Corporation is attempting to achieve this (Kaplan, 1993).

Recommended development process of BS

The phases of the process

There are two phases of development of BS at a company:

- Conception of the idea of BS
- Implementation of BS with a provision for feedback and learning (Kaplan & Norton, 1996a & b)

Conception phase includes translating the vision and formulation of a new strategy. This phase is followed by implementation phase. Implementation phase starts with communicating and linking the strategy up and down the organisation and linking it to departmental and individual objectives. The next stage is integrating financial and business plans. The final stage is providing feedback and learning to improve BS, strategy and vision.

While translating the vision into strategy, involvement of line managers helps at more levels in the organisation. The more the involvement, the higher the rate of adoption of a business change of this magnitude. The higher the involvement, the more the feedback into the process from downstream managers. This will be more in sync with the new customer-focus strategy. The downstream employees are closer to the customer. So, they have a better grasp of measures that drive customer satisfaction. In addition, gaining consensus will be facilitated by involving more number of people than in the current process.

If the organization is a functional one, change in organisational structure puts a premium on leadership skills. A general management approach to business-profitability is to be imbibed in every manager. The essence of this change is better realized with the involvement of larger segment of managers in the implementation of BS.

Deployment Considerations

BS is a living scorecard; it needs to be updated as new learning pours in while using it. So, deployment and constant updating is important. Deploying BS requires more than just communication. There is a need to change the perceptions and attitudes of workforce,

augment its grasp of how the business worked, and focus every individual's attention on his or her behavior in front of the customer. To begin with, the real barrier will be misunderstanding of BS and its measures. Misunderstanding is also a barrier to trust. This can be overcome with learning maps, dialogue and action plans. A learning map is a larger picture of service station that leads to small groups of participants through a business or historical process.

Communicating the benefits of the new management system could be initiated by bringing out the differences between the traditional measures and BS (Table 1). This will also help in acculturating the new mindset required to make BS an ongoing activity. In this scheme of things, there is a premium set on leadership skills that managers should have in order to implement BS. These skills are listed in Table 2.

Table 2: Leadership skills

Customer Needs	People and values	Performance leadership
Customer service orientation	Team skills	Business knowledge and literacy
Empowerment skills	Two-way communication skills	Problem-solving
Interpersonal skills	Valuing diversity	
Initiative and sense of urgency	Development people and valuing their ideas	
Change leadership and integrity		

The compensation system needs to be altered to reflect the new focus on customer satisfaction and employee empowerment, while retaining link with investor measures. Recognition of non-financial measures in the compensation system would drive performance hard to realize the benefits from BS.

A typical example of this process is in order. Long-term executive compensation (incentives) could be based on the following formula:

A quarter weight on employee measures, another quarter weight on customer measures, another quarter weight on operational efficiencies, and final quarter weight on traditional investor measures.

Case Study

This section illustrates through an example the development of a scorecard for Marketing and Refining (M&R) Division, an SBU, of a Fortune 25 oil company.

Problem definition

The M&R Division of the oil company is the fifth-largest U.S. refiner. This SBU operated five state-of-the-art refineries. In 1992, the Division reported an operating loss and ranked poor in profitability among its competitors. A climate survey in 1993 revealed that employees felt that internal reporting requirements, administrative processes, and top-down policies were stifling creativity and innovation. Relationships with customers were adversarial, and people were working narrowly to enhance the reported results of their individual, functional units (Kaplan, 1997).

Recommended solution

If M&R Division were to grow, it had to make the most of its existing assets and focus more intensively on customers, giving motorists what they want, not what the functional specialists in the organisation thought motorists should want. In sum, there was a need to control the costs, to learn to focus on the customer, and to decentralize decision-making in the SBU.

There was a need to control the costs, to learn to focus on the customer, and to decentralize decision-making.

Action steps

Based on the analysis of goals in the competitive environment, the Statement of Vision for the M&R Division should be as follows:

Vision	• To be customers' preferred provider and global leader
Strategy	• Increase shareholder expectations • Provide services that delight their customers (by providing value) • Strive for continuous improvement and to leverage core competencies • Improve quality of employees and employee attitudes

To sustain profitability, and quality of life at the M&R Division, a new strategy (customer-focus, empowerment of people, and cost control) was devised to replace the earlier strategy (volume growth and broad product line to all segments of customers). An Executive Leadership Team was formed to determine strategic themes for BS (Kaplan, 1997). Based on the findings provided by the Executive Leadership Team, the strategic objectives for

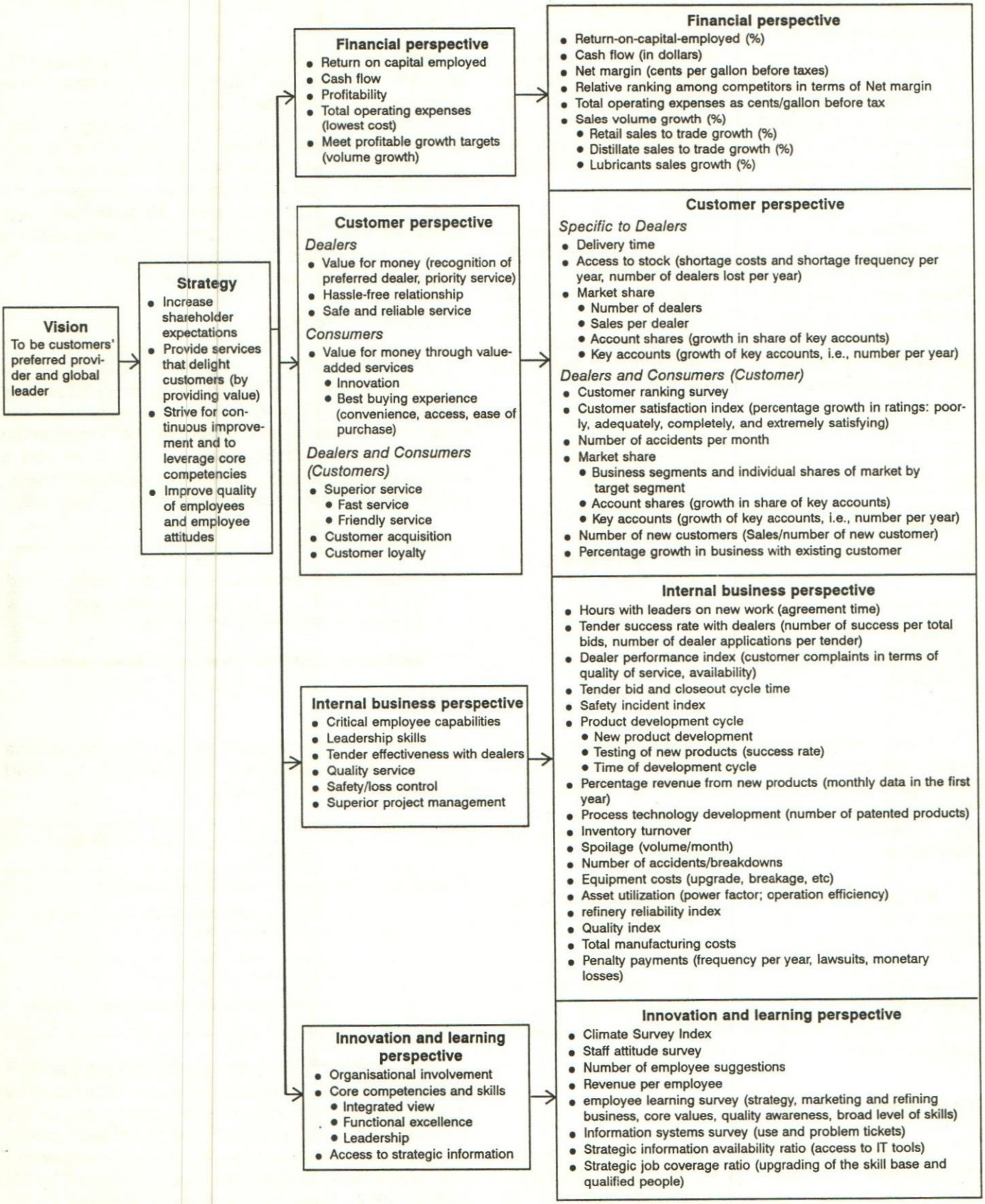

Fig. 3. The Balanced Scorecard of M&R Division

M&R Division can be expanded into the following measures (summarized in Fig. 3).

A new strategy (customer-focus, empowerment of people, and cost control) was devised to replace the earlier strategy (volume growth and broad product line to all segments of customers).

Financial Perspective

The goal is to reduce costs, increase profitability and achieve business growth. The strategic theme from financial perspective is:

Reward shareholders by providing a superior long-term return which exceeds that of peers in the industry.

The strategic objectives from financial perspective are:

- Return on capital employed (ROCE): Earn a sustained rate of ROCE that is consistently among the best performers in the downstream industry, but no less than the agreed corporate ROCE.

- Cash flow: Manage operations to generate sufficient cash to cover at least the SBU's capital spending, net financing cost, and pro rata share of the Corporate shareholder dividend

- Profitability: Continually improve the profitability by generating an integrated net margin (cents per gallon) that consistently places the SBU as one of the top two performers among the downstream players in the industry.

- Total operating expenses (lowest cost): Achieve sustainable competitive advantage by integrating various portions of the value chain to achieve the lowest fully-allocated total consistent with the value delivered.

- Meet profitable growth targets (volume growth): Grow the business by increasing volume faster than the industry average, and by identifying and aggressively pursuing profitable fuels and lubes revenue opportunities that are consistent with the overall division strategy.

These objectives translate into the following measures:

- Return-on-capital-employed (%)
- Cash flow (in dollars)
- Net margin (cents per gallon before taxes)
- Relative ranking among competitors in terms of Net margin
- Total operating expenses as cents/gallon before tax
- Sales volume growth (%)
- Retail sales growth (%)
- Distillate sales to trade growth (%)
- Lubricants sales growth (%)

Learning and Growth Perspective

The goal is empowerment of people through human resources and information technology (IT) initiatives. The IT initiatives should emphasize knowledge management in the division. The strategic theme from learning and growth perspective is:

Develop and value teamwork and the ability to think company-wide, act locally.

The strategic objectives from financial perspective are:

- Organisational involvement: Enable achievement of vision by promoting an understanding of SBU's organisational strategy and by creating a climate in which employees are motivated and empowered to strive toward that vision.

- Core competencies and skills: Integrated view—Encourage and facilitate people to gain a broader understanding of the marketing and refining business from end to end.

Functional excellence—Build the level of skills and competencies necessary to execute SBU's vision.

Leadership—Develop the leadership skills required to articulate the vision, promote integrated business thinking and develop people.

- Access to strategic information: Develop the strategic information support required to execute the strategies.

These objectives translate into the following measures:

- Climate Survey Index
- Staff attitude survey
- Number of employee suggestions
- Revenue per employee
- Employee learning survey (strategy, marketing and refining business, core values, quality awareness, broad level of skills)
- Information systems survey (use and problem tickets)
- Strategic information availability ratio (access to IT tools)
- Strategic job coverage ration (upgrading of the skill base and qualified people)

Customer Perspective

There are two types of customers—franchised dealers and consumers who purchase company's products from independent dealers and retailers.

Problems

Traditionally, M&R Division has emphasized volumes and margins growth. In this scheme of things, dealers did not have sufficient incentive to improve their services. So, quality of dealer service was at its low ebb. Also, there was no focus on customer requirements and market trends.

New strategy

- A win-win channel partnership strategy strives to improve dealer/wholesale marketer profitability through customer-driven products and services and by developing their business competencies. It advocates emphasis on dealer's value for money in addition to quality of service to the dealer. The aim is to increase dealer's gross margins while trying to get their support to improve their quality of service. Point-of-sale promotions and supporting merchandising activities at the portals of wholesalers and retailers will go a long way to achieve this end.
- The new customer-focus strategy advocates to understand customer needs better than anyone and offer them products and services which exceed their expectations. It targets only the non-price-sensitive consumer segments. The strategic theme is: identify and fulfill the value propositions for the target consumers (speed, smile, stroke) while maintaining and improving the "price of entry" items. So, the new value proposition is:

  value = (fast + friendly + safe) service

Value proposition to the consumers is to be through service stations and convenience stores. The aim is to make their buying experience the best-buying experience. Interplay among customer acquisition, retention, and lifetime profitability is at the heart of the comprehensive measurement system proposed in "The Right Measures", Chapter 8, The Loyalty Effect (Reichfeld, 1996). Reichfeld advocates incorporation of explicit value drivers to and from the customer. Based on this, the strategic objectives from customer perspective are:

Dealers

- Value for money (recognition of preferred dealer, priority service)
  - Hassle-free relationship
  - Safe and reliable service

Consumers

- Value for money through value-added services
  - Innovation
  - Best buying experience (convenience, access, ease of purchase)

Dealers and Consumers (Customers)

- Superior service
  - Fast service
  - Friendly service
- Customer acquisition
- Customer loyalty

These objectives translate into the following measures:

Specific to Dealers

- Delivery time
- Access to stock (shortage costs and shortage frequency per year, number of dealers lost per year)
- Market share
- Number of dealers
- Sales per dealer

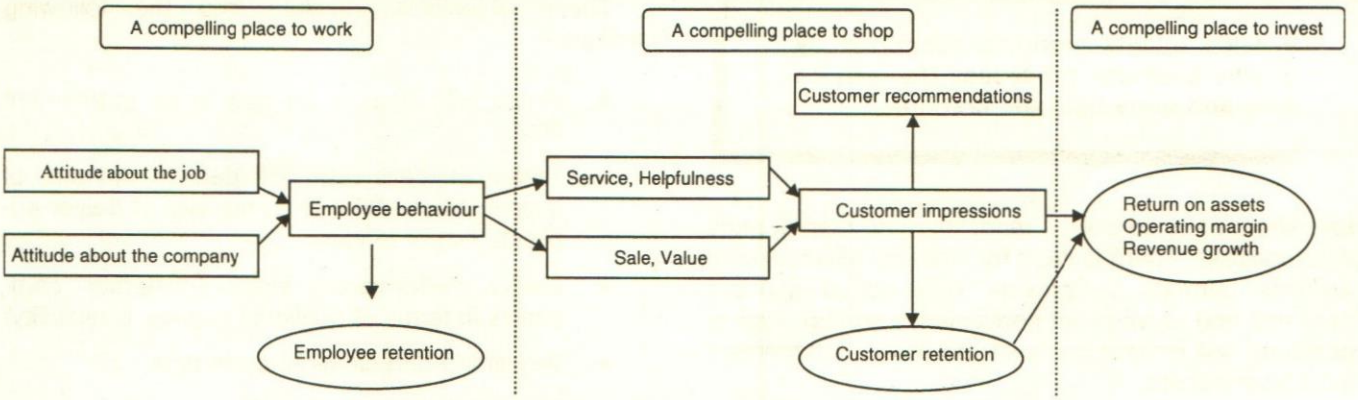

Fig. 4. Customer perspective: Employee-Customer-Profit Chain Model

- Account shares (growth in share of key accounts)
- Key accounts (growth of key accounts, i.e., number per year)

Dealers and Consumers (Customers)

- Customer ranking survey
- Customer satisfaction index (percentage growth in ratings: poorly, adequately, completely, and extremely satisfying)
- Number of accidents per month
- Market share
  - Business segments and individual shares of market by target segment
  - Account shares (growth in share of key accounts)
  - Key accounts (growth of key accounts, i.e., number per year)
- Number of new customers (Sales/number of new customers)
- Percentage growth in business with existing customers

The employee-customer-profit chain is given in Fig. 4. A typical questionnaire to measure "compelling place to work" index could be as given in Table 3.

Internal Business Perspective

The business unit is in its mature phase of the cycle. Since the business is to be sustained and the investments made are to be harvested, the business warrants no new investment. Investment projects will be more directed to relieving bottlenecks, and enhancing continuous improvement, rather than the long payback and growth option investments that were made during the growth stage. The main goal is to maximize cash flow back to the corporation.

Table 3: A sample questionnaire

Attitude about the job	Attitude about the company
• I like the kind of work I do.	• I feel good about the future of the company.
• My work gives me a sense of accomplishment.	• The company is making the changes necessary to compete effectively.
• I am proud to say I work at the company.	• I understand our business strategy.
• How does the amount of work you are expected to do influence your overall attitude about your job?	• Do you see a connection between the work you do and the company's strategic objectives.
• How do your physical working conditions influence your overall attitude about your job?	
• How does the way you are treated by those who supervise you influence your overall attitude about your job?	

The strategic themes are as follows:

- Maintain a leadership position in safety while keeping the refineries fully utilized.
- Provide product to terminals at a cost equal to or better than the competitive market leader.
- Protect the health and safety of employees, the communities in which the SBU works, and the environment the company shares.
- Provide quality products supported by quality business processes that are on time and done right the first time.

The supply team: To become competitive suppliers, the transfer price of the products moved to the

Provide quality products supported by quality business processes that are on time and done right the first time.

downstream should not be more than the market price of competitors. There is need for strategic alliances with business partners to provide value-added services (products and services for convenience stores). Typical measures will include costs of inventory management and delivery costs.

The manufacturing team: The manufacturing team needs to focus on operating parameters at the refineries. It needs to improve operational efficiency of its plants, and to reduce cycle time of production in order to meet customer demands on time. Also, the delivery systems need to be safe and reliable. There is a need to reduce manufacturing costs through continuous improvement of business processes. At the same time, emphasis should be placed on maximizing asset utilization. In order to retain customers, perfect order fulfillment is a definite measure. This demands accurate forecasting of targets for manufacturing, and reducing bullwhip effect. Bullwhip effect can be minimized by reducing fluctuations in ordering patterns of dealers. This can be achieved through effective channel partnering. Point-of-sale promotions and supporting merchandising activities at the portals of wholesalers and retailers will go a long way. Second, the team should develop products that are in tune with the demands of the market. This requires emphasis on research and development of new products and process technologies.

Environmental Health & Safety: An oil company needs to maintain the image of a socially responsible company. This requires that it emphasize measures that track accidents, spillovers, lawsuits, penalty payments due to legal considerations, among other things.

In line with these factors and the goal to meet the demands of customers from product development to marketing, the strategic objectives from internal business perspective are:

- Critical employee capabilities
- Leadership skills
- Tender effectiveness with dealers
- Quality service
- Safety/loss control
- Superior project management

These objectives translate into the following measures:

- Hours with dealers on new work (agreement time)
- Tender success rate with dealers (number of successes per total bids, number of dealer applications per tender)
- Dealer performance index (customer complaints in terms of quality of service, availability)
- Tender bid and closeout cycle time
- Product development cycle
  - New product development
  - Testing of new products (success rate)
  - Time of development cycle
- Percentage revenue from new products (monthly data in the first year)
- Process technology development (number of patented products)
- Inventory turnover (millions of lbs)
- Spoilage (volume/month)
- Number of accidents/breakdowns (Environmental)
- Safety incident index (number of days away from work)
- Equipment costs (upgrade, breakage, etc.)
- Asset utilization (power factor; operation efficiency)
- Total manufacturing costs
- Refinery reliability index
- Quality index
- Penalty payments (frequency per year, lawsuits, monetary losses)

Conclusions

BS has emerged as the remedy to the limitations of measuring only short-term financial results. A company would derive the maximum value from its scorecard if the BS is at the core of its strategic management system, not just the measurement system. To this end, it needs to implement BS in its entirety with the precautions and future applications in place. Most importantly, the company should recognize that the development process is a living one. That is, it improves upon itself after receiving con-

A company would derive the maximum value from its scorecard if the BS is at the core of its strategic management system, not just the measurement system.

tinuously channeled feedback and learning from the implementation process. As is evident from the case example, a change in the value proposition alters the measures in the scorecard.

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MANAGEMENT THOUGHTS : BY PRAMOD BATRA

The human mind is like a parachute, it only works when it is open

A closed mind is like a gloomy cave made gloomier by the cob of ignorance and prejudice.

An open mind is like a sunny meadow where fresh ideas sprout a blossom.

In the history of mankind, whenever man has opened the shutters of his mind, healthy new ideas have breezed in. And he has vigorously stepped out of his narrow confines to discover continents and oceans, planets and galaxies.

But whenever man has shut out new ideas and gone into hibernation in the safety of old, rigid norms, the human civilization has been shrouded by the gloom of Dark Ages.

Now shake yourself out of your slumber. Step out of the den of stagnant thoughts, into the open field of bold new ideas. Soar high on the strength of an exploring mind to reach unknown heights of achievement and success.

□ Think Inc., Batra

Feature

Performance Benchmarking in Technical Education: A Pilot Study

A. Srividya & Bhimaraya A. Metri

In this paper performance benchmarking study conducted on students of Computer Science and Electronics Engineering Departments of two "A Grade" Engineering Colleges affiliated to Mumbai University has been presented. Survey data has been analysed and performance analysis has been carried out to identify gap and improvement opportunities. Finally, recommendations have been made for both the colleges.

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Since the world is changing fast, Indian education sector doesn't have a choice; it must change with the world. It must make commitment today to start challenging its traditional way of doing things. Higher education in India is functioning traditionally with little improvements; there is a growing dissatisfaction and frustration among the students regarding poor facilities. One of the most important challenges facing the education sector is improvement in performance through pursuit of best practice standards.

Imperatives in Technical Education

The majority of institutions are yet to realise the significance of competition in engineering education. The environment is bound to become more competitive. Since all institutions affiliated to universities offer broadly the same type of syllabus, it is the quality of what they have to offer which will determine whether they are successful in attracting students. The successful institute will increase its reputation by providing high quality learning experience for students. This encompasses quality of academic programmes, and also quality in how well students are treated in all other aspects of the service provided by the institute (Kanji, 1995).

It is important to identify target areas, which are priorities for quality improvement in accordance with the view of the main group of customers—the students. Customer satisfaction is probably the most important element of TQM which is reflected by the weight assigned to it in the Malcolm Baldrige National quality Award (MBNQA) criteria—25 per cent of the possible points are in the customer focus and satisfaction category (Sirvanci, 1996). Customer satisfaction is often used synonymously with quality, since quality is frequently defined as meeting and exceeding customer needs. Customer focus provides direction for improvement efforts. Without well-defined customer focus, quality effort can easily be defused. Students are the

primary beneficiaries of education, their true satisfaction is a valid performance measure. Therefore student evaluation and satisfaction are appropriate measures of performance.

Quality is frequently defined as meeting and exceeding customer needs. Customer focus provides direction for improvement efforts.

Quality education reflects on the performance of various economic sectors like manufacturing, service, non-profit and government. To give best quality education, institutions must turn to benchmarking as a way to meet the myriad quality challenges they face because it provides a model for action. Successful implementation of benchmarking in manufacturing industry is reflected in improved performance (Metri, 1999). The benefits of benchmarking are still largely unrecognized in higher education. There is a need to explore the potential of benchmarking in this sector.

Benchmarking Study Methodology

One of the most important tools for assessing quality is benchmarking. It is the search for industry best practices that lead to superior performance (Camp, 1989). For the purpose of performance benchmarking, model of study methodology has been developed as presented in Fig. 1. This model includes five phases:

Benchmarking is the search for industry best practices that lead to superior performance.

Phase 1: Familiarisation

Phase 2: Development of benchmarking instrument

Phase 3: Data collection

Phase 4: Data analysis

Phase 5: Recommendations

Familiarisation: Students of the Quality Planning & Analysis course, M. Tech. Reliability Engineering were selected as team members to develop a benchmarking instrument. Since benchmarking was not well understood, a three-day training session was conducted. Team members also spent a week referring benchmarking literature. The team thus got familiarized with benchmarking methodology.

Developing Benchmarking Instrument: Benchmarking subject was introduced to team members through the application of Nominal Group Technique (NGT). Factors affecting quality of technical education were identified during six NGT sessions of 2 hours each. From the NGT sessions, benchmarking team members obtained a consensus conclusion on the factors required for improving the quality of education. Using the factors identified in the NGT sessions, authors developed the survey questionnaire in two parts—on part I, 'how important the various factors are, to improve the quality of education' and part II on 'how the college is performing with respect to these factors.' In both parts, participants were asked to rate on 1-5 scales.

Data Collection: Computer Science and Electronics Departments are the emerging branches in this Information Technology era. Therefore, these two departments of two "A Grade" Engineering Colleges affiliated to Mumbai University were selected for the pilot benchmarking study. These colleges have been designated as A and B to maintain confidentiality. 82 sample students of Computer Science and Electronics were randomly selected for the in-person survey.

Data Analysis: Once the data was collected, analysis following in two parts. Importance/performance indices were computed for each of the 33 factors using the formula:

Importance Index/performance index (I)

$$= \left(\frac{\sum_{i=1}^{5} a_i x_i}{5 \sum_{i=1}^{5} x_i} \right) (100\%) \qquad (1)$$

Where, a_i = Constant expressing weight given to i;

x_i = Variable expressing frequency of response for i;

i = 1, 2, 3, 4, 5.

Importance index indicates the students' expectations i.e. benchmark; and performance index shows the performance of the colleges. Table 1 presents the benchmark and performance index for college A & B.

In the second part, gap analysis i.e. the difference between what was seen as important by the students (i.e. benchmark) and how they think colleges are performing has been carried out. The larger the gap be-

Table 1: Importance and performance of factors in College A and College B

Code	Factors	Importance Index (Benchmark)	Performance Index	
			College A	College B
I. Academics				
REP	Reputation of the institute	89.02	85.36	79.23
FAC	Faculty	88.78	40.36	55.38
TTQ	Teaching Techniques (Models, Charts, Experiments, Demos, Tutorials)	79.51	39.64	45.38
SSR	Staff & student Relationships	80.49	46.79	58.46
PAS	Personal Attention to Students	76.83	35.36	44.62
SEE	Special Effort For Extraordinary Students	69.27	33.57	53.85
SEB	Special Effort For Below Average Students	77.80	30.36	43.85
CLS	Classroom facilities	78.78	59.29	66.92
LAB	Laboratory facilities	91.46	42.86	61.54
LIB	Library facilities	94.15	53.93	54.62
SAT	Student achievement due to teaching	81.71	37.50	53.08
SAS	Student achievement due to self study	89.27	89.64	79.23
SAP	Student achievement due to parental guidance	70.24	56.70	61.54
SAA	Student achievement due to additional coaching	61.71	46.43	60.77
II. Extra-Curricular Activities				
QED	Quiz, essays, debating, painting etc.	62.68	78.57	72.31
CUA	Cultural Activities	67.32	73.93	74.62
EDT	Educational Tours	49.27	83.21	38.46
EXI	Exhibitions	58.05	77.86	48.46
NSS	N.S.S., N.C.C. etc.	51.95	56.07	36.92
III. Behavioural Study				
TAT	Teacher Attitude	87.32	42.86	50.77
STA	Student Attitude	88.05	69.29	73.85
PAT	Parent Attitude	75.61	66.07	67.69
ISR	Inter Student Relationship	85.37	76.43	71.51
IV. Miscellaneous				
COC	Counseling Cells	78.54	41.43	54.62
PPD	Special Programmes For Personality Development	67.56	31.43	53.46
CGC	Career Guidance Cell	84.88	40.71	47.69
VTI	Visits To Industries	87.07	35.36	33.08
ETI	Expert Talks From The Industry People	83.17	49.29	50.00
EPW	Emphasis On Project Work	86.83	58.21	54.62
VOT	Vocational Training	80.00	40.00	47.69
COM	Computational Requirements	82.93	46.07	57.69
RES	Revision Of Existing Subjects	83.17	40.71	51.54
SPT	Sports	77.07	59.64	65.38

tween importance and performance, the greater the scope for improvement. Tables 2 and 3 show the results of the gap analysis based on the rankings of each of the 33 factors. Thus, gap analysis identifies the strengths and weaknesses and focuses on the most important areas to be tackled.

Gap analysis identifies the strengths and weaknesses and focuses on the most important areas to be tackled.

Performance Analysis

Table 1 reveals that students have given utmost importance to library facility. The library acts like the brain and nerve system for any technical institution. The quality of learning is greatly influenced by the quality of available library facility. Thus, library should be well-equipped. Second rank in the importance list is the laboratory facilities. This is the place where student understands the co-relation of theory and practical, recognizes that the real world of engineering is different from the simulated one as encountered in classrooms. Next important factors are self-study and faculty. Motivation

and extra facilities improve the students' performance through self-study. The heart of any educational programme is its faculty. Quality of students coming out from any institution depends on the quality of teachers. By effective teaching and with right attitude, students can become great achievers. The next factor, visit to industries gives exposure to field practices. From Table 1 it is observed that 17 factors have importance index above 80 and therefore these factors play a key role in improving the quality performance of education system.

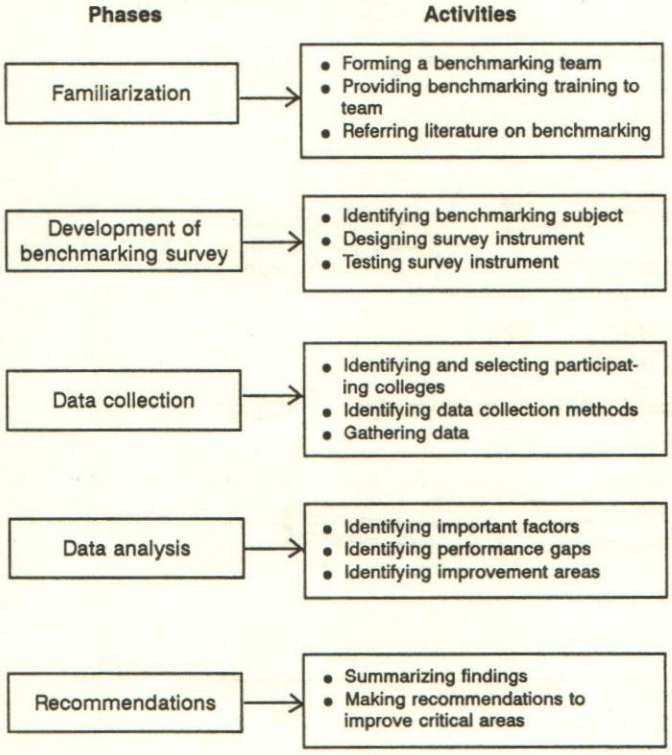

Fig. 1. Model of Study Methodology for Benchmarking in Education

From Table 1, it also appears that, there is a huge gap in academics, behavioral study and miscellaneous areas between student expectation and college performance. There is a dire need for both the colleges to improve a lot in these areas to satisfy the students. However, in the area of extra curricular activities students are happy with the existing activities.

In college A, out of 33 factors, performance of 11 factors is observed to be very poor indicating a gap of more than 40 (Table 2). In academics, maximum number of factors i.e. 6 factors namely, laboratory facilities (LAB), faculty (FAC), Special efforts for below average students (SEB), student achievement due to teaching (SAT), personal attention to students (PAS) and library facilities (LIB); in behavioral study only one factor i.e. teacher's attitude (TAT); in miscellaneous areas, four factors namely, Visit to industries (VTI), career guidance

Table 2: Performance Gaps for College A

Factor Code	Benchmark	Perform-ance	Gap	Priority Rank
I. Academics				
LAB	91.46	42.86	48.61	1
FAC	88.78	40.36	48.42	2
SEB	77.80	30.36	47.45	3
SAT	81.71	37.50	44.21	4
PAS	76.83	35.36	41.47	5
LIB	94.15	53.93	40.22	6
TTQ	79.51	39.64	39.87	7
SEE	69.27	33.57	35.70	8
SSR	80.49	46.79	33.70	9
CLS	78.78	59.29	19.49	10
SAA	61.71	46.43	15.28	11
SAP	70.24	56.79	13.46	12
REP	89.02	85.36	3.67	13
SAS	89.27	90.00	–0.73	14
II. Extra-curricular activities				
NSS	51.95	56.07	–4.12	1
CUA	67.32	73.93	–6.61	2
QED	62.68	78.57	–15.89	3
EXI	58.05	77.86	–19.81	4
EDT	49.27	83.21	–33.95	5
III. Behavioural study				
TAT	87.32	42.86	44.46	1
STA	88.05	69.29	18.76	2
PAT	75.61	66.07	9.54	3
ISR	85.37	76.43	8.94	4
IV. Miscellaneous				
VTI	87.07	35.36	51.72	1
CGC	84.88	40.71	44.16	2
RES	83.17	40.71	42.46	3
VOT	80.00	40.00	40.00	4
COC	78.54	41.43	37.11	5
COM	82.93	46.07	36.86	6
PPD	67.56	31.43	36.13	7
ETI	83.17	49.29	33.89	8
EPW	86.83	58.21	28.61	9
SPT	77.07	59.64	17.43	10

cell (CGC), revision of existing syllabus (RES) and vocational training (VOT) show performance well below the expectations of students. In college B, only one factor i.e. visits to industries (VTI) shows very poor performance whose gap in terms of importance index is 54 (Table 3). However, looking at the benchmark, college B needs to improve in library facilities (LIB), career guidance cell (CGC) and teacher's attitude (TAT) on priority basis.

On comparison of performance of college A with

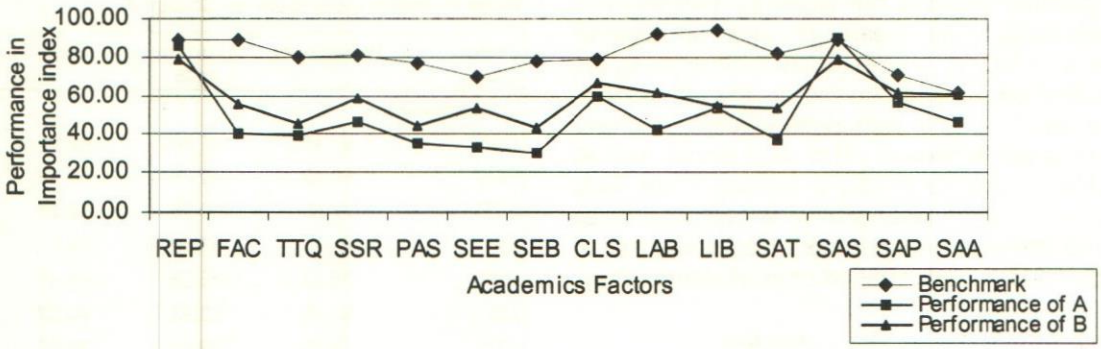

Fig. 2. Performance of Colleges A and B in Academics

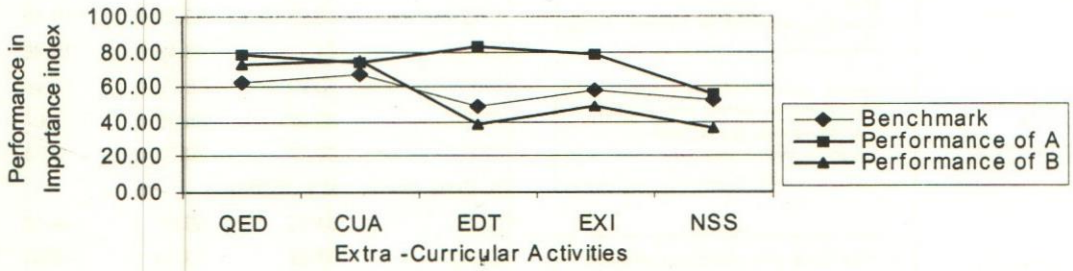

Fig. 3. Performance of Colleges A and B in Extra-curricular Activities

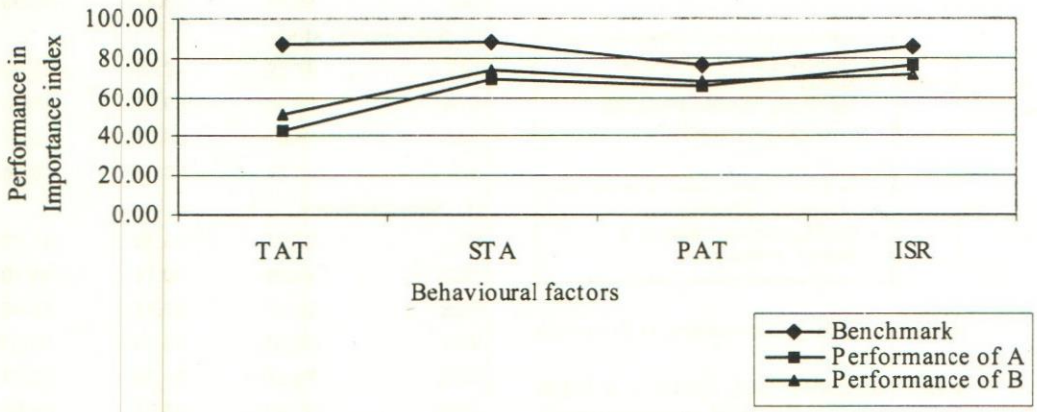

Fig. 4. Performance of Colleges A and B in Behavioural Study

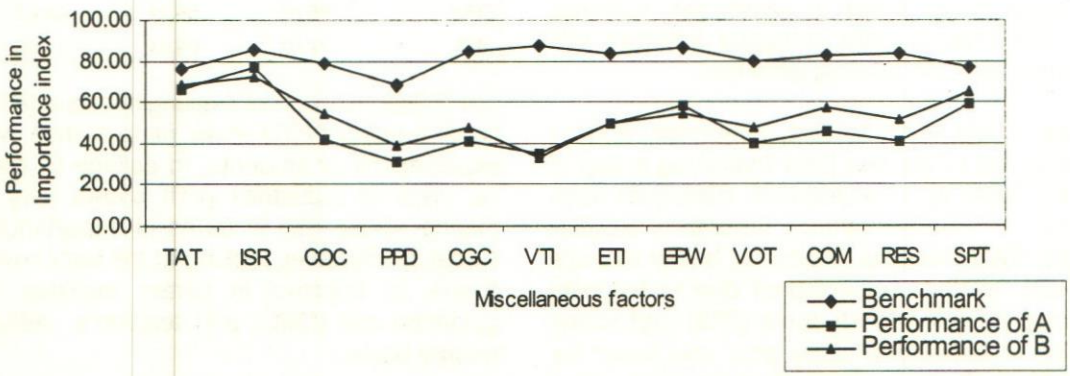

Fig. 5. Performance of Colleges A and B in Miscellaneous areas

Table 3: Performance Gaps for College B

Factor Code	Benchmark	Performance	Gap	Priority Rank
I. Academics				
LIB	94.15	54.62	39.53	1
TTQ	79.51	45.38	34.13	2
SEB	77.80	43.85	33.96	3
FAC	88.78	55.38	33.40	4
PAS	76.83	44.62	32.21	5
LAB	91.46	61.54	29.92	6
SAT	81.71	53.08	28.63	7
SSR	80.49	58.46	22.03	8
SEE	69.27	53.85	15.42	9
CLS	78.78	66.92	11.86	10
SAS	89.27	79.23	10.04	11
REP	89.02	79.23	9.79	12
SAP	70.24	61.54	8.71	13
SAA	61.71	60.77	0.94	14
II. Extra-curricular activities				
NSS	51.95	36.92	15.03	1
EDT	49.27	38.46	10.81	2
EXI	58.05	48.46	9.59	3
CUA	67.32	74.62	–7.30	4
QED	62.68	72.31	–9.62	5
III. Behavioural study				
TAT	87.32	50.77	36.55	1
STA	88.05	73.85	14.20	2
ISR	85.37	71.54	13.83	3
PAT	75.61	67.69	7.92	4
IV. Miscellaneous				
VTI	87.07	33.08	54.00	1
CGC	84.88	47.69	37.19	2
ETI	83.17	50.00	33.17	3
VOT	80.00	47.69	32.31	4
EPW	86.83	54.62	32.21	5
RES	83.17	51.54	31.63	6
PPD	67.56	38.46	29.10	7
COM	82.93	57.69	25.23	8
COC	78.54	54.62	23.92	9
SPT	77.07	65.38	11.69	10

College B, it is revealed that college B is superior to college A in all areas except extra-curricular activities (Table 4). Out of 33 factors, college A is performing well in 9 sub-areas (factors) and poorly in 24 sub-areas whereas college B is performing well in 24 sub-areas and performing poorly in only 9 sub-areas. Figures 2-5 show the graphs of benchmark and performance of colleges A & B in all the four major areas of technical education. College A can benchmark those 24 sub-areas against college B to improve performance. Critical areas of college A which need improvement are: Special efforts for extra ordinary students (SEE), laboratory facilities (LAB), student achievement due to teaching (SAT), faculty (FAC), student achievement due to additional coaching (SAA) and special efforts for below average students (SEB).

Table 4: Performance Analysis of College A with College B

Factor Code	Performance of College B	Performance of College A	Performance Gap in College A
I. Academics			
SEE	53.85	33.57	20.27
LAB	61.54	42.86	18.68
SAT	53.08	37.50	15.58
FAC	55.38	40.36	15.03
SAA	60.77	46.43	14.34
SEB	43.85	30.36	13.49
SSR	58.46	46.79	11.68
PAS	44.62	35.36	9.26
CLS	66.92	59.29	7.64
TTQ	45.38	39.64	5.74
SAP	61.54	56.79	4.75
LIB	54.62	53.93	0.69
REP	79.23	85.36	–6.13
SAS	79.23	90.00	–10.77
II. Extra-curricular activities			
CUA	74.62	73.93	0.69
QED	72.31	78.57	–6.26
NSS	36.92	56.07	–19.15
EXI	48.46	77.86	–29.40
EDI	38.46	83.21	–44.75
III. Behavioural study			
TAT	50.77	42.86	7.91
STA	73.85	69.29	4.56
PAT	67.69	66.07	1.62
ISR	71.54	76.43	–4.89
IV. Miscellaneous			
COC	54.62	41.43	13.19
COM	57.69	46.07	11.62
RES	51.54	40.71	10.82
VOT	47.69	40.00	7.69
PPD	38.46	31.43	7.03
CGC	47.69	40.71	6.98
SPT	65.38	59.64	5.74
ETI	50.00	49.29	0.71
VTI	33.08	35.36	–2.28
EPW	54.62	58.21	–3.60

Similarly, college B can benchmark against college A for those 9 factors where college A is superior. Table 4 indicates the performance gaps of college A against college B.

Recommendations

Based on the performance analysis, following recommendations have been made for college A and college B to improve upon, in order to meet the expectations of the main customers of the technical institute-students.

- College A should consider improvement in most of the sub-areas as per the priority rank given in Table 2. The top five critical areas to improve are: visit to industries, laboratory facilities, faculty, special efforts for below average students, teacher attitude and student achievement due to teaching.
- College B should increase the frequency of industry visits and consider improving the institute-industry interaction. It also needs to improve library facilities, career guidance cell and teacher's attitude areas.
- College A should benchmark against college B in most of the areas of academics, behavioural study and miscellaneous.
- College B should benchmark against College A in extra-curricular activities (except cultural activities), reputation of institute, parents' guidance, inter-students relationship, visit to industries and project work areas.

Conclusions

Any organisation in the economic sector regardless of size or type may undertake benchmarking and adopt the technique for its own improvement. The pilot study described here has clearly demonstrated that benchmarking can be applied to technical education sector. In this study, relative importance of the factors influencing the quality of education have been established and actual collage performance has been benchmarked against customer (students) expectations for internal knowledge and forward planning. By understanding the strengths and weaknesses of colleges, improvement areas have been identified. Benchmarking study helps the engineering colleges to plan to match or even surpass customer needs and stay one step ahead of their competitors. Therefore, developing benchmarking study for higher education is an important means to improve the performance of technical education in India.

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Feature

Industrialization & Environment: Dilemma of Third World Countries

Bhaskar Majumder

Industrialization is an unavoidable indication of development—and transformation of natural resources for industrialization is accompanied by environmental degradation. We assume no trade-off between people of present and future generations. But the type of development pursued now will have a spillover effect on the present generation and also on the generations to come. A new look at industrialization is thus necessary. If mankind is to live over generations, the nature that feeds it has to be sustained. This leads us to the question of controlling man's exercise of power over nature. The paper tries to show the way how the state can ensure its own authority through legislating guiding principles for protection of nature without obstructing industrialization as an objective of development.

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There is no escape from industrialization if an economy is to develop (Singh, 1979). An economy may be understood as a structure of production and consumption of utilities. In an engineering sense, production is a technical transformation of inputs into output. In an economic sense, production implies the transformation of nature by man through technological knowledge and social cooperation. This transformation yields commodities which carry use-value and exchange-value. Natural resources, by themselves, do not have exchange-value, unless they come in the domain of trade. Even when they are not tradable, these resources have two values—use-value and 'option-value' (Dasgupta & Maler, 1997). 'Irreversibility' in the use of natural resources shows the extension of human choice in using these resources at a future date. When man exercises his choice now in using and transforming resources, he has to ensure regeneration of these resources for his future use and use by his future generations.

When man exercises his choice in using and transforming resources, he has to ensure regeneration of these resources for future use.

Economy & Ecosystem

Conversion of natural resources is accompanied by environmental degradation (The World Resources Institute, et al, 1998, p. 51). The formation and development of the economy is the cause. In fact, an economy takes birth in the womb of nature where human beings act as catalysts. In the course of nature being transformed the economy grows as a 'guest', and at a mature stage the 'guest' grows at the cost of the 'host', viz, the Earth's ecosystem. A

closer look at the evolution of the ecosystem, however, will show that the ecosystem itself changes independent of the late arrival of human beings on earth. 'Living systems on the Earth have never been immutable entities set in unchanging backgrounds: Living things evolved through geological time, adapted to changing environments, but also having a marked effect on the soils, rocks, atmosphere and oceans. Ecosystems are also dynamic entities, studied today at a stage of their development in which the environment is being continually modified so that it becomes more suitable for the next stage' (Bradshaw, 1979, p. 214). The changes in the earth's ecosystem are not necessarily imposed by actions initiated by human beings as economic agents. Changes in composition of nature have been taking place over centuries leading to different distributions and association of living things. We are concerned here not with the natural geological changes, but with the changes in the natural ecosystem with respect to actions initiated by economic agents. Generally, natural ecosystem is used to mean the system that is not subject to human influences (Remmert, 1980). Today all the ecosystems that exist are influenced by human beings. In fact, many ecosystems evolved together with the human race, man himself being an element in the ecosystems, and the other elements have co-evolved with him (Remmert, 1980).

Growth of economy implies rising physical output where the latter is a transformation of nature by man. In the commodity production space, it shows an evolution through land-based agricultural production to capital-based industrial production, human labour being the common factor in both the cases. The higher stage of growth shows knowledge-intensive production of goods and services. The structural transformation of universal nature and reliance on high-speed industrial growth takes man away from nature in its original form and in the process, distorts nature. In other words, when this transformation of nature by man, instead of showing a symbiotic relationship shows a man-centric effort to conquer nature and ultimately overpower it, the economy that is aimed to be built up by man to protect himself, is itself stressed. This paper deals with the dual consequences of human endeavour, namely industrialization-propelled development and environment-restricted development.

The structural transformation of universal nature and reliance on high-speed industrial growth takes man away from nature in its original form.

Utilization of Natural Resources: Industrialization-Linked Issues

The benefits of industrialization are visible since the days of the first industrial revolution that sprouted from the United Kingdom (UK) more than two centuries back. These are the benefits of a shift from a rural, agrarian economy to an urban, industrial economy, or in other words, the benefits of a shift from lower-order technology based lower-order products to higher-order technology-based higher-order products. However, the costs associated with this industrialization that got manifested from the beginning were not questioned during those days of the 18th and the 19th centuries. These questions are being raised now, e.g., industrialization-borne air and water pollution and increasing exposure to health hazards, human displacement and other socio-economic costs (The World Resources Institute, 1998). One can not recapture the services of the ecosystems lost through industrialization. This loss is, however, not independent of any compensating benefits. Costs and benefits often emerge over time separately and may affect people of the same and different generations differently. 'Bio diversity loss does not always serve the future ill. Indeed, the enormous worldwide growth in material production over the last three centuries is largely based on the specialization of natural resource base, and on the loss of bio diversity. While it can be argued that many of the future costs of the past specialization in the use of biotic resources were consistently ignored, and are only now beginning to be understood, it is also very clear that much bio diversity loss has improved the human condition' (Perrings, 1997, p. 211).

Bio diversity loss does not always serve the future ill. Much bio diversity loss has improved the human condition.

The rates of industrial growth in developing countries after the Second World War have outpaced the growth rates of European industrialized countries. A part of this growth, industrial wastes are growing in quantity and becoming more varied, more toxic, and more difficult to dispose of or degrade' (The World Resources Institute, 1998, p. 51). 'The developing countries of Asia and the Pacific are economically the fastest growing group of countries in the world, with an average growth rate in GDP of 7 per cent during 1991-94 compared with the world economic growth rate of 1.1 per cent. Although growth of this order and magnitude has been instrumental in reducing the incidence of poverty... it has been accompanied by serious en-

vironmental problems' (UNEP, 1997, P. 54). It is also observed by the UNEP that the industries in the developing countries are air-cum-water polluting since these industries are iron, steel, fertilizer, cement that use fossil fuels, particularly coal, as primary source of industrial energy. Use of natural resources for industrialization has not only endangered the need to maintain the long-run capacity of the earth, but has also endangered the short-run capacity of agriculture. What is meant by this capacity? 'The carrying capacity of an ecosystem is the maximum stress it is capable of absorbing without it changing to a vastly different state. Ecosystems are endemically subject to natural shocks and surprises. The self-reorganizing ability of ecosystems determines its capacity to respond to the perturbations they are continually subjected to' (Dasgupta & Maler, 1997, p. 4). The carrying capacity degrades by 'environment deterioration – including soil erosion, aquifer depletion, range land deterioration, air pollution' etc. (Brown & Mitchell, 1998, p. 168). Since such degradation adversely affects agriculture, it adversely affects industries too. The impact is also felt beyond national boundaries, for example, in case of rivers and global commons.

Use of natural resources for industrialization has not only endangered the need to maintain the long-run capacity of the earth, but has also endangered the short-run capacity of agriculture.

It is often alleged that the process of industrialization in the Third World Countries (TWCs) is more material-intensive than what it is in Developed Market Economies (DMEs). It is a fact that the production-system in DMEs today is less material-intensive, relative to not only what it is in TWCs but also relative to their own past production processes. 'Possibilities of substitution among resources may mean that minerals are becoming less important in the production of goods and services over time. Fiber optics are being used instead of copper wire in telecommunications. Cellular phones eliminate the need for wiring of any sort between users. Plastics are used instead of zinc in automobiles. Recycling of a myriad of products reduces the need to use raw materials' (Hartwick & Olewiler, 1998, p. 50). The TWCs are yet to acquire this type of development of technology and choose the product-set that are knowledge or brain-intensive that the DMEs now can boast of because of their great leap forward in technology. An opinion has been floated of late that 'the huge material flows associated with industrialization can be reduced in developing economies if these countries go directly from the pre-industrial to the post-industrial stage of development, leapfrogging the intermediate stage' (Brown & Mitchel, 1998, p. 171). This is impractical and unacceptable for any country in the Third World aspiring for industrialization. What is more serious is that the DMEs, particularly the United States, export health hazards to other countries, particularly to the TWCs who are linked with the DMEs, directly or indirectly, through trade-aid-finance-technology-defense (The World Re-sources Institute, 1998). The problems that emerge from the attempted industrialization in the TWCs thus are not always specific to the national needs. The problems are embedded in their attempts to follow the technology-cum-demand structure of DMEs and in their attempts to catch up with the economic structure of the DMEs within a few decades. The DMEs developed their own structure over the last two centuries. Now the DMEs are shifting from capital-using and labour-saving industrialization to information-cum-brain intensive production, and hence developing a new production-cum-trade structure. The TWCs are also advised to follow the path. The fact is that the major industries in the TWCs accused of generating pollution are the same industries that promoted industrial development in the countries now called the DMEs during the last two centuries. Thus, the advice ignores the history of industrialization of countries now bracketed as DMEs and the role of the DMEs in transfer of environmental 'bad' to the TWCs.

DMEs as the Promoter of Environmental 'Bad'

'Many developing countries still depend heavily on their exports of minerals and other commodities, mostly in unprocessed or only intermediately processed forms. In the case of several major minerals such as aluminum and nickel, a few transnational corporations control the whole industry, from mining through final processing' (World Commission, 1987). Even if the TNCs (Transnational Corporations) operating in the TWCs follow skill or brain intensive methods of production, it does not solve the general problems of the TWCs in their efforts to ensure industrialization. The context of international economic order which the TWCs of post-Second World War had to accept makes their position vulnerable vis-a-vis the DMEs. The fact is that 'the developed countries can enjoy their current consumption levels precisely because the developing countries are subject to deprivation, and it is extremely doubtful, from a resource point of view, whether the poor nations can ever achieve similar standards as the rich' (Reddy, 1981). It may also be that the advice either presupposes that the TWCs have already attained the stage of industrialization that the DMEs attained by pre-Second World War period or ignores altogether the socio-economic reality of the TWCs.

The developed countries can enjoy their current consumption levels precisely because the developing countries are subject to deprivation.

There is no doubt that rapid industrial growth has converted nature into a suffocating space spreading air pollution, water pollution and hazardous wastes. Transnationalization is no less responsible for this polluting environment in TWCs where labour costs are significantly lower relative to what they are in DMEs, hence encouraging the TNCs to relocate their production. During 1992-94, exports of banned and restricted pesticides from ports in US to the developing world totaled more than one lakh metric tons (The World Resources Institute, 1998, p. 44). Industrialized countries now generate about 90 per cent of the world's hazardous wastes (World Commission, 1987, p. 226). The amount of the wastes crossing national boundaries has been increasing over time. 'Between 1982 and 1983, wastes transposed in Western Europe for disposal in another country virtually doubled... This increase may be attributed partly to the availability of relatively low-cost, legal land-based disposal facilities in some countries. For example, about 4,000 shipments of hazardous wastes went from the Netherlands to the German Democratic Republic in 1984. And the Federal Republic of Germany sent about 20,000 shipments to the German Democratic Republic the preceding year... Small and poor countries are especially vulnerable to offshore dumping, as has occurred in the waters of the Pacific and the Caribbean' (World Commission, 1987, p. 227-228). It is thus not only a question of tackling the industrialization-linked maintenance or, possibly productivity-linked expansion of, resources but also one of planning localization of industrial production. The role of the State in resource-maintaining-cum-generating industrialization has to be understood in this national and global context.

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TWCs Dilemma regarding Environment-Related Industrialization: Indian Context

The TWCs can not escape from their dependence on natural resources including minerals and agricultural products as their consumables and exportables, because of the comparative stages of production and technology vis-a-vis the DMEs. These TWCs depend on forest produce like timber, for example, for their exports and thus deplete the resources at source (World Commission, 1987, p. 67-68). The demands of the DMEs for material-intensive goods and raw materials from the TWCs have also imposed a heavy economic-natural cost on the TWCs. This is often termed the colonial division of labour that the TWCs continue to follow long after their decolonization. The problem is that the kind of non-tariff barriers the TWCs face, whether they are product-related or process-related, the process or the standard set by the DMEs in terms of environment and/or labour, corner the TWCs in international trade and hence in production possibilities. Starting with an unequal exchange relationship in international trade because of a number of reasons the root of which lies in perpetuation of colonial division of labour, the TWCs are further kept under pressure by the DMEs in terms of environment-linked non-tariff barriers.

What can be the options for countries like India in the TWCs facing environment-linked trade restrictions? Should it be changing the exportable product mix? Should it be producing safe products, whether or not promoting exports? This is where the TWCs dilemma on industrialization comes. On the one hand, these countries need speedy industrialization. On the other, they are dependent on the DMEs for technology including machinery and finance for such industrialization. Technology dependence is alleged to be because of poor R&D, while finance dependence is alleged to be because of foreign exchange shortage. Earning of foreign exchange is basically dependent on promotion of exports. Promotion of exports by the TWCs is dependent on the steady demand from the DMEs. The type of exportable products of the TWCs makes them vulnerable not only in terms of trade but also in terms of depletion of resources and surrendering the future options for development. The task of the TWCs then is to shift from material-intensive products both for internal use and for exports to knowledge-intensive products. It means producing more of a product with same material resources or producing it with less material resources. For small economies in the TWCs, where smallness is understood as the small size of population with low purchasing power, the narrow resource base inadequate to supply goods in keeping with rising needs of the population etc., options like changing product-mix or changing product destinations are difficult. The small economy can not escape from being export-dependent and that too on one or two DMEs. Unless small economies develop their own relevant technologies, they remain dependent on a few DMEs. Large

The task of the TWCs is to shift from material-intensive products both for internal use and for exports to knowledge-intensive products.

economies like India can change both exportable product mix and export destinations. They can also afford to remain less dependent on exports. But ultimately issue related with quality and safety of products produced, cannot be ignored because they will be tested by the buyers, be they internal or external. The precise point is that environment-linked questions can not be bypassed by being less dependent on exports to the DMEs or avoiding export itself. It can not remain surprising for long why the process should also be questioned at the global level, because ultimately it is the quality of human life and the human rights that matter in any economic transaction.

Large economies like India can change both exportable product mix and export destinations.

Concluding Comments

We assume no tradeoff between people of present and future generations, by any indices of social benefits and costs. But the concern always remains for the present since the type of development pursued now will have a spillover effect on present generations and also on the future generations. Development thus has to integrated industrialization with preservation of natural and environmental resources.

The question of an alternative pattern for industrialization arises when the existing pattern is not sustainable. Environmental degradation expressed as erosion of natural resources and reducing capacity of the ecosystem to ensure the attempted industrialization the world over is a significant indicator of the shocks that industrialization imposes on future generations of people. Technological progress that promotes industrialization itself poses major environmental problems, but technological progress can also be the panacea (World Bank, 1998/99, p. 107). While technological progress unearths resources for immediate consumption, it also saves resources by discovering alternative uses in producing the same and different products. The concern at present is protecting the future generations against an 'all-cost situation' that they may face from an 'all-benefit situation' that the present generation may aim at, from the present type of industrialization. This concern is also valid for the present generation, depending on the phases of industrialization. Thus, attempts are now needed to use, protect and regenerate resources for industrialization to succeed.

One of the reasons for deteriorating environment at both national and global levels is that the market did not tell the truth (Brown & Mitchell, 1998, p. 181). The privileged polluters like the producers and users of automobiles are usually untouched by the government. Governments tax income because it is administratively an easy way to collect revenue, but the cost due to pollution caused by the automobiles incurred by people who suffer from respiratory illness is not borne by the beneficiaries. The more industrialized countries responsible for emission of carbon and sulfur dioxide do not pay anything to the non-polluter or less polluter countries. At the national level then, the 'visible hand' of the State has to intervene, initiate steps for eco-friendly industrialization. State is empowered by fiscal instruments, pricing policies, acts and regulations. Imposition of taxes on environmentally destructive activities not only brings revenue to the government but also checks those activities. The task is not skipping industrialization but regulating it.

Imposition of taxes on environmentally destructive activities not only brings revenue to the government but also checks those activities. The task is not skipping industrialization but regulating it.

The question of use, protection, and renewal of natural resources requires at first ensuring the preconditions for appropriate utilization of existing resources. Some of these resources are already unearthed, some are used and exhausted, some are in use but not exhausted, and some are yet to be discovered. But if mankind is to live over generations, the nature that feeds them has to be kept alive. This is the context where the role of the State comes in. 'Where the workforce and financial resources permit, national governments should establish clear environmental goals and enforce environmental laws, regulations and incentives, and standards on individual enterprises. In formulating such policies, they should give priority to public health programmes associated with industrial pollution and hazardous wastes' (World Commission, 1987, p. 219). Following Organisation for Economic

National governments should establish environmental goals and enforce environmental laws, and incentives, and standards on individual enterprises.

Cooperation & Development (OECD) guideline, one principle is 'Polluter Pays Principle' (PPP) where PPP is 'intended to encourage industries to internalize environmental costs and reflect them in the prices of products' (World Commission, 1987, p. 221). Economic (market) measures can also lead to reducing environmental hazards and maintaining resources. For example, pricing of water and energy for production purposes may lead to minimum necessary utilization of these resources. The problem of easy execution of private right over public property may be tackled through state administration and peoples' cooperation. The solution for safe life over generations does not lie in stopping utilization of resources nor in blocking industrialization, but in new searches for better utilization of resources so that industrialization is resource-saving and resource-replenishing and not resource-exhausting.

Solution for safe life over generations does not lie in blocking industrialization, but in new searches for better utilization of resources.

The conventional economic instruments for environmental protection and management of natural resources center on property rights and market. The operational parts of these instruments are financial and fiscal, and also include some incentives and disincentives for the plants and firms (UNEP, 1997, p. 133). While these instruments are mostly in use in the OECD, in the TWCs, property rights and market formations are not similar to those in the DMEs. In the developing world, there is considerable emphasis on communal management systems. For the TWCs then 'transferring the responsibility of resource management to local communities and allowing them a fair share of the benefits arising from economic activities associated with non-cultivated biological resources' helps preserve and protect natural resources (UNEP, 1997, p. 134). In the course of protecting and managing natural resources in the TWCs, industrial development can not be bypassed. China may be an example here. The emphasis of the environmental policies in China is to ensure environmental protection in keeping with national socio-economic development and, maximizing the economic, social, and environmental benefits (UNEP, 1997, p. 158). 'China has introduced industrial discharge permits and emission charges that double or even triple if the allowable discharge standard is exceeded' (UNEP, 1997, p. 134). China's system includes both market-based and command-and-control instruments. For the countries in the Third World the instruments however vary.

Protection and preservation of natural resources now are more global and regional than national and local. Regional groups like European Union (EU), Association of South East Asian Nations (ASEAN), South Asia Cooperative Environment Programme (SACEP) etc are taking steps in this direction. For example, in July 1993, the ASEAN Senior Officials on the Environment (ASOEN) agreed on the development of a new Strategic Plan of Action on the Environment (1994-98), which may provide a model for other regional organisations. India is included in the South Asia Co-operative Environment Programme (SACEP) that implements an Action Plan called SACEP's Strategy and Programme (1992-96) (UNEP, 1997, p. 165). EU started the initiatives long back since 1957 when there came European Agreement concerning the International Carriage of Dangerous Goods by Road (UNEP, 1997, p. 165, 175). At the global level, the Intergovernmental Negotiating Committee (INC) has made progress on the development of an Internationally Legally Binding Instrument for the Application of Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (UNEP, 1997, p. 130).

In the framework of regional and global actions and initiatives, the question of industrialization-linked protection of natural resources in the TWCs is to be analysed. The TWCs can not afford to question the environment-unfriendly industrial production of the DMEs that occurred during pre-Second World War period. The basic reason is the emergence and establishment of a globally unchallenged International Economic Order (IEO) with all the legal-financial-administrative institutions executing this order. Previous bad committed by person A can not be cited to support an alternative to yet-to-be current good by person B. The TWCs thus have no alternative other than selecting products, processes, location of production etc. which are environmentally safe. This safety is to be understood by international standard, and hence determined by the highest standard, attained in the environmentally first ranking countries. There is thus no alternative to clean and efficient use of energy and minerals in the TWCs, lesser stress on land, water and forestry, lesser conversion of land for non-agricultural purposes, sustainable consumption-cum-production, capacity building of individuals for information-cum-knowledge intensive

production etc. The guidelines for such safe production-cum-technology may come from regional and global institutions, but the best solution lies within the production sector of a national economy itself. The task of the state in the national context is to let these production units know what 'safety rules' they are supposed to ensure and what cost they are to bear for violation.

Some of the State-sponsored steps for environment-linked industrial development for countries like India may be

- Identifying common protectable resources
- Joint management of resources
- Restrictions on export of minerals
- Development of a National Eco-Fund
- Planned location of Hazardous Plants
- Promotion of awareness through Environment-education, training, campaign, public discussion, use of public media etc.,
- Promotion of R&D for safe industrialization.

Human life over generations can not be compromised for easy production-cum-consumption for the present generation in any country in the world.

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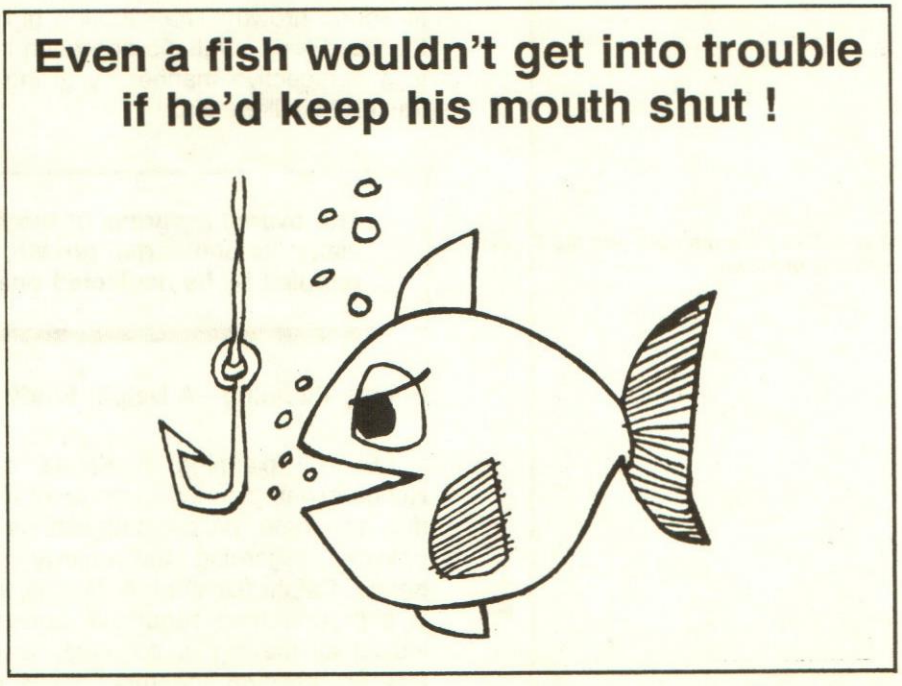
MANAGEMENT THOUGHTS : BY PRAMOD BATRA



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Feature

Strategic Energy Policy in the Developing Context of Kerala

V. Nanda Mohan & Anitha S. Ramachandran

Increasing energy demands of households have crippled the industrial prospects of Kerala. Here an attempt has been made to reach consensus on expert opinion on strategic energy policy formulation in the developing context of Kerala.

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Even if Kerala was seemingly energy surplus till early eighties, due to its industrial backwardness, the persistent increase in household demand has converted the energy 'surplus' state into an energy deficit one. It is now widely accepted that the overall progress of the state, especially its industrial growth, has been crippled by its neglected energy sector. It is paradoxical that in a state with higher standards of life reflected by indicators like high literacy, high health standards, more political awareness etc., the per capita energy consumption is one of the lowest in the country and stands as a major obstacle in the furtherance of industrialisation. Industrialisation requires energy in sufficient quantities and as it is not forthcoming in required quantities, it obstructs the process of industrialisation in the state in a big way. Had Kerala resorted to a strategic energy policy and made available energy in sufficient volume, the state would have been characterized by significant all round growth. The situation highlights, even if late, the need for a strategic approach in shaping economy in a perspective manner by giving priority for key infrastructure like energy.

The overall progress of the state, especially its industrial growth, has been crippled by its neglected energy sector.

Energy Planning – A Delphi Study

Energy planning in Kerala is a complex task. Hence it was planned to conduct a Delphi study to arrive at some policy suggestions based on expert opinions regarding the energy status/prospects of Kerala. Delphi (Linstone & Murray, 1975, Murray, 1970) is a programmed sequential approach. Instead of an individual making a forecast, a group prepares a forecast keeping the three basic characteristics viz.,

anonymity, iteration with controlled feed back, and statistical group response taking care of minority views. Under this method a structured formal and detailed questionnaire is given by mail or in person. Apart from direct questions, the participants may be asked to respond to scaled objective items and sometimes to open ended responses. The responses of the participants are analysed, combined, averaged, and represented in quartiles and medians. Questions for the second round are made with modifications if necessary. The average response of the first round are provided to the participants along with the second round questionnaire. After scrutinising the answers to the second round, respondents in the upper and lower quartiles may be asked to justify their responses. Further iterations (rounds) are continued if necessary.

The quality of output of Delphi study depends on the experts. The list of experts covered in this study included officials of Kerala State Electricity Board, Engineering Colleges, V.S.S.C, ANERT, BARC, NTPC, as well as environmentalists and other persons having competence in the area. As a first step, certain areas of importance in the field of energy in Kerala were identified. This was mainly done by literature survey and after several discussions with experts. Twenty two issues were identified for framing the Delphi questionnaire. Accordingly in the first round, there were 22 questions.

Questions were prepared in the form of statements. The seven point scale used to get the response rating in terms of agreement/disagreement was Strongly agree, Agree, Moderately agree, Cannot answer, Disagree, Moderately disagree and Strongly disagree. In the case of certain questions, time points were identified instead of the seven point scale. In addition to this a matrix was constructed to estimate the environmental impacts of different sources of energy. Within each cell of the matrix, experts were asked to assign a score ranging from 1 to 10 representing the increasing size or magnitude of the impact. This they carried out, irrespective of their current field of expertise based on their general knowledge and awareness. The experts were also asked to give their self rating (expertise) as a percentage. The first round questionnaire was sent to 75 experts, of which 43 responded.

Analysis was based on rating given by each expert. From the 22 questions of each questionnaire, the rating on each question was considered. In arriving at a conclusion, a uniform pattern of approach was employed. At first the responses of the experts were arranged in ascending order and the three quartiles were computed. The median value (value of the response at second quartile i.e. (Q2) was considered as the consensus answer of the question. To see whether there is consensus among the experts, the quartile deviation i.e., semi-inter quartile range was estimated by taking half of the difference between third quartile (Q3) and first quartile (Q1). Consensus was assumed in those cases where, the semi-inter quartile range [(Q3–Q1)/2] is less than or equal to 1.5.

As consensus was reached in the case of certain questions, a second round Delphi study was carried out. The 43 respondents of the first round were selected for the second round, as the second round questionnaire was based on the response to the first one. 33 experts responded and their responses were analyzed. The procedure adopted was similar to the first round. The experts were given the median value of each question as well as their first response and were asked to revise their rating if necessary. If they did not agree with the median value, the reasons for disagreement were also sought. As certain experts revised their responses, in the second round, we were able to come to a consensus on almost all the issues except in the case of the health and environmental impact of nuclear energy (for health impact the median value is 7 with a quartile deviation of 3.5 and for the environmental impact the mean value is 5 with a quartile deviation of 3).

Results

The following are the expert opinions under hydro, thermal, nuclear, non-conventional as well as risk components of different sources of energy.

Hydro Energy

- The hydel potentiality of the state is 3000 MW. Due to environmental factors the exploitation of potential schemes has been shelved in the state.

  Majority of the experts believe that the intensity of environmental factors is high on the potential hydro schemes. Even though a statistical consensus has been reached over the issue, certain experts expressed their view that the environmental issues are highly site specific and therefore should not be generalised. An expert opined that the development of the hydro power potential of a wild free flowing river means a complete and permanent destruction of the river valley and a complete upset of regional ecology.

- There is much potentiality of developing small hydro projects economically.

  Consensus has been reached on the potentiality of developing small hydro projects economically. According to an expert, dams and check dams can be constructed for continuous flow of water in rivers

and for raising the water table so that the yield from wells and ponds can be increased during summer.

- Should Kerala go for more hydel plants to meet the energy deficit?

  Certain experts expressed the view that Kerala has not even utilised 40 per cent of hydel potential whereas most of the European countries have utilised more than 90 per cent. This might be the reason why a consensus has been arrived at for developing more hydel projects in Kerala. But there are experts who believe that when alternative energy sources are available, it is short sighted engineering to contemplate further hydro development.

When alternative energy sources are available, it is short sighted engineering to contemplate further hydro development.

- On an average Kerala gets 1900 MU per annum of energy from national power grid. In future also, Kerala can depend on the national grid for minimum 25 per cent energy.

  Regarding dependence on the national power grid, the mean value has been 'moderately agree'. Certain experts are of the opinion that the rate of growth of internal consumption has no bearing on the receipt of power from National Grid.

- To what extent (in %) can Kerala minimise transmission/distribution loss by technological improvement, (the present transmission loss in Kerala is more than 20 per cent whereas in advanced countries like Japan, it is less than 5%).

  The transmission and distribution system of Kerala is inefficient due to outdated technology and poor maintenance. Through technological improvement Kerala can minimise transmission and distribution loss to the extent of 11 per cent—there has been consensus with little differences of opinion.

- There is a general feeling that tremors experienced in Idukki are to a certain extent due to the presence of large reservoirs.

  In the first round, experts were not able to come to a consensus over the issue of whether the temors experienced in Idukki are due to the pressure of large reservoirs or not. The mean value was disagree. Certain experts who have been closely associated with the above case remarked that studies made by a number of Indian and Canadian scientists have clearly established the fact that the above feeling is baseless. In the second round feed back, some experts revised their opinion, the quartile deviation has narrowed thereby coming to a consensus with the opinion that the large reservoirs are not the root cause of tremors experienced in Idukki.

Thermal Power

- Should Kerala go for more of coal based thermal plants?

  Regarding the development of coal based plants in Kerala a consensus was reached among experts with the mean value as "moderately agree". A few experts strongly disagreed as coal is not available in Kerala and hence the transportation of coal from far away places causes lot of problems.

- Of Thermal and Nuclear energy plants, which is more suitable in Kerala?

  Considering the high population density of Kerala, there is very strong consensus among experts in developing thermal plants instead of nuclear plants in the state.

- Concerning the waste disposal of thermal and nuclear plants, there has been strong consensus among the experts. Almost all agree to the fact that waste disposal is less risky in the case of thermal plants than nuclear plants considering the technology development for the manufacture of bricks from fly ash.

Waste disposal is less risky in the case of thermal plants than nuclear plants considering the technology development for the manufacture of bricks from fly ash.

Nuclear Energy

- Kerala may also go for more nuclear energy plants for meeting the energy deficit of the state—

  Even though there has been no consensus in the first round, some experts revised their responses in the second round, and thereby the quartile deviation narrowed down with the mean value as "disagree" to this suggestion.

- Possibility of developing highly safe small scale nuclear reactors capable of being sited near cities of Kerala—

Majority of the experts are of opinion that this can be achieved only after 2000. But a pro nuclear expert opined that the existing nuclear plants can be established closer to cities even now as they are perfectly safe.

Non-conventional Energy

- Regarding non-conventional energy sources, the possibility of developing solar energy commercially (for instance photo-voltaic cells) can be achieved only after 2000. Almost all experts agreed to this.
- Consensus could not be reached in the first round over the issue of the emergence of wind power generation on a commercial footing in Kerala. Hence this issue was taken up in the second round of the Delphi study where a statistical consensus has been arrived. In fact, experts are of opinion that the wind power generation on a commercial footing in Kerala could be achieved by the year 2000.
- On viability of wave energy projects on a commercial basis in Kerala, a very strong consensus among the experts was arrived at. There is almost unanimous opinion suggesting development only after 2000 AD.
- Regarding realisation of the southern gas grid and large capacity energy storage system applying super conduction, the experts opined both, only after 2000. Quartile deviation in both cases being also negligible shows strong consensus.
- During the early 1980's i.e. upto 84-85 there has been a highly significant growth rate in the number of bio-gas plants. In fact the growth rate was more than 200 per cent in 84-85. But after 84-95, Kerala experienced a significant decrease in the growth rate of bio-gas plants. The average growth rate after 84-85 has been around 20 per cent. Considering this trend in the number of bio-gas plants, majority of the experts agreed that by 2000 the growth rate would be in the range 10-20 per cent.
- Energy conservation studies based on End Use (conducted in states like Karnataka) have established that about 30-40 per cent energy can be saved. With strong consensus experts agree that there is much scope for such energy conservation (through end-use orientation) in Kerala also.
- It is widely recognised that energy is much under priced in India, especially in Kerala. Majority of experts are in favour of effecting normal pricing by which Kerala can conserve much energy while the excess revenue generated can be utilised for the proper maintenance of generators and plants. The mean consensus value is found to agree.

Majority of experts are in favour of effecting normal pricing by which Kerala can conserve much energy while the excess revenue generated can be utilised for the proper maintenance of generators and plants.

- Regarding the extent to which Kerala can increase the unit price of energy (in percentage) no consensus was reached in the first round as the inter quartile range was high. But in the successive rounds, as certain experts revised their opinion, consensus was arrived at with a mean value of 11 per cent. Certain experts have suggested the introduction of the slab system; according to some others price should also be related to category of user and time of use.
- Understanding the success of the private energy sector in advanced countries, a good number of experts welcome the development of the private energy sector in Kerala also. In fact, there is consensus over this suggestion among the experts.

Risk Analysis

In order to estimate the risk of different sources of energy, a matrix was constructed. The different sources of energy taken are natural gas, oil, coal, nuclear, hydro, small hydro and non-conventional. The risk components studied are health risk, accidents risk, environmental risk, waste disposal risk, and, dread risk. Within each cell of the matrix, the experts were asked to assign a score ranging from 1 to 10 representing the increasing size or magnitude of the impact. On comparison of the mean value of all the different sources of energy, nuclear energy has been the highest.

The following is a desegregated look into the different risk components of various sources of energy.

The health impact of different sources of energy: Except in the case of nuclear energy consensus was reached in the first round itself. For nuclear energy the quartile deviation has been as high as 3.5 with a mean value of 7. In the second round also there was no change in the quartile deviation and hence consensus was not reached over this issue. Next to nuclear energy, the health risk of coal was found to be high followed by oil and natural gas. For non-conventional energy and hydro, the health risk has been negligible.

The second risk component deals with accidents relating to the various forms of energy. Here also, ex-

cept in the case of nuclear energy, consensus was arrived at in the first round. In the second round of the Delphi study as some experts revised their opinion, the quartile deviation decreased thus coming to a consensus. For nuclear energy the mean value obtained has been "8" followed by coal as "3".

Regarding environmental risks, no consensus was reached again for nuclear energy even after the second round. This can be due to the strong bias among the anti nuclear experts. With respect to the mean value ("5"), the environmental risks of nuclear energy and coal are the same. This is followed by hydro, oil and natural gas. In the case of non-conventional energy and small hydro, all experts unanimously agreed the environmental effect to be negligible and therefore the quartile deviation is zero.

Now coming to waste disposal, risk is found to be least in the case of thermal plants than nuclear plants. A maximum score of 10 has been assigned as the mean value for nuclear energy whereas the mean value for coal is only "5". (Mean value of waste disposal risk for other forms of energy are as follows: Natural Gas "2", Oil"2", Hydro, Small Hydro, and non conventional "1").

Finally, dread risk is maximum for nuclear energy followed by coal, oil and natural gas. For small hydro and non-conventional energy, the dread risk is almost negligible and a very strong consensus was reached.

Conclusion

It has been inferred from the expert opinion study that for hydro, the environmental risk is high. Natural gas comes next with comparatively low risk. Natural gas is followed by oil in the risk factor table. The risks associated with the different components of coal are sufficiently high whereas for accidental risk and dread risk, the mean value has been less. Nuclear energy has been found to be the most risky form of energy where the risk is maximum for waste disposal. Besides waste disposal risk in nuclear, its dread and accidents risks are high. Health risks of nuclear energy is also found to be significant. Only the environmental risk has been found to be slightly less in nuclear.

The mono-energy source policy followed by Kerala upto now has proved to be disastrous due to the limitation of hydro potential, inefficient project management and uncertainties of the monsoon. Opposition from ecologists and environmentalists for hydro electric projects has added to the problem of augmentation of power within the state. To meet the ever-growing increase in the demand for energy every effort should be applied for harnessing alternative forms of energy in an economical manner. In fact, less energy intensive industries like Information technology, tourism etc. could be developed in Kerala. An energy crisis is imminent in the state if there is any further negligence of planning of the energy sector. Strategic energy planning for the state is the only key to the solution.

The mono-energy source policy followed by Kerala upto now has proved to be disastrous due to the limitation of hydro potential, inefficient project management and uncertainties of the monsoon.

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Feature

Production & Export Scenario of Cotton in India

Jagdeep Kaur, Balkar Singh Dhillon & Karam Singh

The study analyses the export performance of cotton with respect to its domestic production and movement of world prices. Inferences drawn can provide direction to policy and decision makers.

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Cotton, the most important cash crop in India, has significant export prospects and also plays a dominant role in the agro-industrial economy of India. Cotton production and textile manufacturing together are prime sectors next only to agriculture in India in terms of income and employment generation. 27 percent of the total world cotton acreage is in India. On the production front, India ranks third producing 2787 thousand metric tons and accounting for 14 per cent of the total world cotton production, next to USA and China. As a user, India consumes approximately 14.5 per cent of world cotton (second to China).

Over a period of two decades, India has made considerable progress from chronically deficient situation to self-sufficiency and as an exporter of raw-cotton. The export value of cotton yarn, fabrics and cotton for the period April 1997 to February 1998 was 11,910 crores. But the country has still miles to go in order to ensure a second place of honour as an exporter of quality cotton (Kulkarni's Report, 1998).

But cotton exports have shown downward plunge in the recent past. Export of raw-cotton declined from 16 lakh bales in 1996-97 to 9.7 lakh bales in 1997-98. As a result prospects for cotton exports are looking bleak. This study is designed in this background with the following specific objectives:

- To study the export performance of cotton from India,
- To identify the movement of Indian and world cotton prices, and
- To study the elasticities of raw-cotton export from India.

Methodology

To achieve the stipulated objectives of the study,

secondary data were collected from various issues of The Statistical Abstracts of India, Economic Survey & Indian Cotton Annual. To study the export performance of cotton, tabular method and simple measures of dispersion have been used. In order to identify India's relative advantage in cotton prices for export, compound growth rates of domestic prices (minimum support price, wholesale price and F.o.b. price of cotton) as well as world cotton prices were collected, using the experimental form of the function for the period 1980-81 to 1997-98. To estimate export elasticities and factors affecting export of raw-cotton from India, both linear and log-linear functions were tried, with total exports as a variable dependent upon production in India and the world, total world consumption, relative prices and government policy of quota allotment for export. The Cobb-Douglas type function was selected on the basis of econometric consideration such as higher coefficients and statistical significance of the coefficients. The detailed form of the function is follows:

$$Y = ax_1^{b_1} x_2^{b_2} x_3^{b_3} x_4^{b_4} x_5^{b_5} U.$$

Where, a = constant

b_i = Regression coefficient (i = 1, 2 ...n)

Y = total export quantity of raw cotton from India

x_1 = total production of cotton in India

x_2 = total production of cotton in the world

x_3 = total consumption of cotton in the world

x_4 = ratio of world cotton price divided by the domestic wholesale price of cotton

x_5 = cotton export quota

u = error term

Table 1 shows the area, production and yield of cotton in India from 1960-61 to 1997-98. During 1996-97, India achieved highest level of production. From 1960-61 to 1997-98 production of cotton increased by 3.2 times. Similarly in 1997-98, yield of cotton increased by 2.6 times as compared to 1960-61. The area under cotton increased by 20.4 per cent from 7.6 million hectare in 1960-61 to 8.9 hectare in 1997-98. During the year 1997-98 as compared to 1996-97, production of cotton declined from 177.9 lakh bales to 164 lakh bales because of attack of pests, specially whitefly in Gujarat and American bollworm in Punjab; there was decline in area and yield from 1996-97 to 1997-98 due to the excessive and untimely rains in northern region as well as in Maharastra.

Table 1: Area, Production and Average yield of Cotton in India 1971-72 through 1997-98

Year	Area '000' ha.	Production Lakh bales of 170 kg	Yield kg/ha
1960-61	7,610.0	56.04	125
1970-71	7,605.0	47.63	106
1980-81	7,823.0	70.10	152
1990-91	7,359.0	97.59	224
1991-92	7,661.4	119.00	264
1992-93	7,542.7	138.00	311
1993-94	7,320.5	121.50	282
1994-95	7,925.0	139.00	298
1995-96	9,063.0	162.50	305
1996-97	9,166.0	177.90	321
1997-98	8,865.0	164.00	314

Source: Directorate of Economics and Statistics. Department of Agriculture and Co-operation, Govt. of India.

Table 2 shows the total import and export of cotton from 1970-71 to 1997-98. It is clear that import of cotton has been decreasing since the shift toward production of long and extra-long staple cotton. Exports of cotton have been showing fluctuating trend – it varied from 0.77 lakh bales in 1991-92 to 16.82 lakh bales in 1996-97. Export of cotton is directly related to production of cotton. Whenever production of cotton has increased over the previous stocks, export has also increased. Because of unseasonal rains in the month of Dec., 97 and early

Table 2: Import & export of Cotton (raw) from 1970-71 to 1997-98 (India)

Year	Imports		Exports	
	Quantity (lakh bales of 170 kg.)	Value (Rs in crores)	Quantity (lakh bales of 170 kg.)	Value (Rs in crores)
1970-71	8.50	108.0	1.90	16.6
1980-81	–	–	7.00	150.7
1990-91	–	–	11.90	620.5
1991-92	3.00	194.0	0.77	38.7
1992-93	1.15	90.0	13.77	725.3
1993-94	3.00	306.0	3.90	238.2
1994-95	5.89	543.1	1.08	83.39
1995-96	0.50	N.A.	8.00	961.16
1996-97	0.30	N.A.	16.82	1655.0
1997-98	0.94	82.11	9.70	839.93

Source: Directorate General of Commercial Intelligence and Statistics, Calcutta.

Directorate of Cotton Development, Govt. of India, Ministry of Agriculture, Bombay.

January 1998 export of cotton from India has decreased by 42 per cent – from 116.82 lakh bales in 1996-97 to 9.70 lakh bales in 1997-98 respectively. At the same time, the export value of cotton has declined by 50 per cent from Rs. 1655 crores in 1996-97 to Rs. 839.93 crores in 1997-98.

Table 3 shows that the share of raw-cotton exports in the total value of exports and agricultural exports in India has decreased from 1.35 per cent and 9.19 per cent in 1992-93 to 0.67 per cent and 3.55 per cent in 1997-98 respectively. As compared to the previous year (1997-98) the share of raw cotton exports in the value of agricultural exports has decreased by 51.82 per cent mainly because of the decline in the yield of the crop. Therefore, during the year 1997-98, the value of raw-cotton exports in the total value of India's exports was just 0.67 per cent.

Table 3: Share of value of raw cotton exports in the total value of exports and agricultural exports in India (Rs. crores)

Year	Value of raw cotton exports	Value of total exports	Value of agricultural exports
1992-93	725.3	53688.00 [1.35]	7884.00 (9.19)
1993-94	238.2	69751.00 [0.34]	13021.00 (1.83)
1994-95	83.39	82674.00 [0.10]	13710.00 (0.61)
1995-96	961.16	106353.00 [0.90]	21136.00 (4.55)
1996-97	1655.01	118817.00 [1.39]	24241.00 (6.85)
1997-98	839.93	126290.00 [0.67]	23690.00 (3.55)

Note: Figures in the parentheses [ ] and ( ) are percentages to the value of total exports and agricultural exports.

Source: Directorate General of Commercial Intelligence and Statistics, Calcutta.

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Movement of Cotton Prices

The ratio of domestic cotton prices with respect to world cotton prices is the simplest measure of the situation of comparative advantage. Whether India would continue to enjoy the relative advantage in cotton prices for export would depend on the relative movement of Indian and world cotton prices. If prices in the domestic market in India are rising faster than world prices, then export of raw cotton becomes relatively less remunerative or unprofitable, unless the local currency is devaluated through re-adjustment of exchange rate proportionately. Table 4 indicates that world cotton

Relatively higher increase in the price of raw cotton in domestic market affects export of raw cotton as it reduces the competitiveness and profitability for exporters.

prices increased by 9.35 per cent during the period 1980-81 to 1997-98. Except minimum support prices of raw cotton, both the Fob and wholesale prices increased at a higher rate as compared to world cotton prices. Relatively higher increase in the price of raw cotton in domestic market affects export of raw cotton as it reduces the competitiveness and profitability for exporters. The dollar has shown appreciation with respect to the rupee at the rate of 10.15 per cent per annum which shows that the adjustment of exchange rate through devaluation of the Indian rupee has been offsetting the adverse effect of higher increase in the domestic price of raw cotton.

Table 4: Annual compound growth rates (ACGR) of prices of raw cotton for the period 1980-81 to 1997-98

Prices	Compound growth rates (Per cent per annum)
Domestic minimum support price of cotton	8.69*** (0.53)
Domestic wholesale price of cotton	14.14*** (2.49)
Fob price of cotton from India	9.69*** (1.11)
World cotton price	9.35*** (0.97)
Shadow exchange rate	10.15*** (0.49)

Note: Figures in the parentheses represent standard error of estimates.

Data on prices are in rupees terms.

***Significant at 1 per cent level.

Export Elasticities of Cotton Export

In order to determine export elasticities and factors influencing cotton export from India, two regression equations were tried, one with cotton export quota and the other without it. Cobb-Douglas type of function with quantity of raw cotton export in India as the dependent variable and total production of cotton in India, world cotton production, world cotton consumption and the ratio of world cotton price divided by domestic price of cotton as independent variables were taken in the first equation and in the second equation all the above men-

tioned independent variables including cotton export quota were taken (Table 5). The coefficient of multiple determination (R^2) without the variable of cotton export quota came out to be (0.55) which was significant at 5 per cent level of significance. It indicated that 55 percent of variation in total quantity of raw cotton exports from India was explained by the four explanatory variables included in the first equation of the model for the period 1980-81 to 1997-98.

Table 5: Factors affecting total quantity of raw cotton export from India, 1980-81 to 1997-98

Variable	Regression coefficient	
	(1)	(2)
Constant	75.152*** (35.060)	20.381^{NS} (28.595)
Production of cotton in India	5.507*** (1.659)	0.897^{NS} (1.687)
World cotton production	–9.732*** (2.974)	–4.641* (2.488)
World cotton consumption	0.8546^{NS} (3.454)	2.508^{NS} (2.468)
World cotton price/wholesale price of cotton	1.375^{NS} (1.036)	–0.139^{NS} (0.831)
Cotton export quota	–	0.642*** (0.169)
R^2	0.553**	0.796***

Note: ***, and * denote significant at 1 and 10 per cent level of significance, respectively.

NS – Non-significant.

Figures in the parentheses represent standard error of the estimates.

The cotton export elasticity coefficient with respect to total production of cotton in India was 5.507 which was significant at 1 per cent level of significance, indicating thereby that 1 per cent increase in total production of cotton in India will raise the quantum of cotton export by 5.507 per cent.

1 per cent increase in total production of cotton will raise the quantum of cotton export by 5.507 per cent.

The elasticity coefficient of quantity of cotton export from India with respect to world cotton production was observed to be –9.732 and significant. The negative influence of increase in world cotton production on the quantum of export of raw cotton from India is logical. It indicates that 1 per cent increase in world cotton production would decrease cotton exports from India by 9.732 per cent, because of the increase in world cotton supply.

The elasticity coefficients with respect to world cotton consumption (0.885) and the ratio of world cotton price divided by domestic price of cotton (1.375) were found to be not having significant impact on export of cotton from India. Though the elasticity coefficient of cotton export with respect to the ratio of world and domestic cotton prices turned out to be statistically non-significant, yet the positive sign of the elasticity coefficient is indicative of the expected trend, i.e. higher the world cotton prices in relation to domestic cotton prices, higher would be the export of cotton from India. Thus it can be concluded that production of cotton in India as well as in the world are mainly responsible for the performance of cotton export from India.

Cotton exports are controlled by the Government of India and regularised through quota system periodically, after carefully assessing the demand and supply position within the country. The Government is expected to take the above factors and findings into consideration while deciding the cotton export quota. In such a situation, it could be persuaded that inclusion of export quota as an explanatory variable would thus capture the effectiveness of other variables thereby decreasing their export elasticities and even their level of significance. This is confirmed by the findings of equation 2.

The cotton export quota had highly significant coefficient, goodness of fit improved to 79.6 per cent and other coefficients became non-significant but for world cotton production where coefficient also declined (in absolute terms) and level of significance decreased from 1 per cent to 10 per cent only, their signs remained indicative of the expected directions of influence on the export of cotton.

Conclusion

In order to boost export of raw cotton from India, production should be increased through technological upgradation. Higher domestic prices of cotton would make exports impossible by making India incompetitive in the international arena. In such situations domestic processors would also find it cheaper to import cotton. So efforts should be made to stabilize the volatile fluctuations in prices to a reasonable level which should be fair both for cotton cultivators as well as the cotton industry. Alternatively instead of exporting raw cotton, India can export readymade garments and other value-added products in order to get higher returns and generate more employment.

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Feature

Enhancing Role-Efficacy of Front Line Supervisors: An O.D. Intervention

Anirudh Pandey & S.M. Khan

Improvement in quality and quantity of performance is not merely a function of hardware but depends to a large extent on the human side of the organisation. In this context, Role-efficacy interventions for workers, supervisors and managers have been initiated in the Indian Railways. This paper presents the results of some interventions conducted on a sample of 91 front line supervisors of Central and Western Railways.

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Supervisors play a pivotal role in the functioning of Indian Railways. They are a link between workers and management, and get the policies translated into work. On the Indian Railways, they have been assigned jobs like inspecting, coaching, monitoring, counselling and ensuring safe and efficient work-performance of workers. With ever growing complicated technological upgradation, increased work related tension among workers, lack of close contact with actual work, lack of power to deal with staff and a general change in the attitude of workers due to social change, the job of supervisor has undergone a sea change. In such a changed scenario, what meaning a supervisor gives to his role i.e. how he perceives his job, becomes a matter of concern to the railways as well as to the general public. Faulty perception of his job is likely to be reflected in bad performance of workers. It also invites danger to public life and damage to public property, pollutes work place relations, invites strikes, absenteeism of workers and loss of production to the organisation.

Faulty perception of job is reflected in bad performance. It also invites danger to public life and damage to public property, pollutes work place relations, invites strikes, absenteeism of workers and loss of production.

Role Efficacy

Perception of role as a framework for understanding the interactions of individuals with their roles and resultant outcomes has generated increasingly greater interest in the last two and half decades. Proper perception of role or perception of greater opportunity in performing one's role has been named as Role-efficacy. Role-efficacy in the Indian context was proposed by Pareek

(1980a, 1980b, 1986, 1987 and 1993). According to him, if organisations assist individuals to define their roles and if individuals are willing to share this concern through appropriate strategies, then, it may be possible to improve work place relationship and increase productivity of organisations.

Attempts have been made to establish relationship of role-efficacy with personal and organisational dimensions. In regard to personal dimensions, role-efficacy has high and positive relationship with internal locus of control, intra-persistive coping styles (solving the problem by one's own efforts), Cattell's cyclothemia (broadly speaking, people orientation), surgence (extraversion), adventuresomeness (outgoing tendency), general satisfaction, role-satisfaction, job satisfaction and quality of work life. (Sen, 1982; Surty, 1983; Gupta & Khandelwal, 1983; Klinefelter, 1991, Mishra, 1998). Role-efficacy has negative relationship with externality, role-stressors as well as total role-stress, impunitive coping style, Cattell's dominance and Machiavalianism, alienation and defensiveness (Sen, 1982; Surty, 1983; Singhala, 1985, Pandey, 1997). Role-efficacy has several forms of correlation with age, experience, number of children and age of children (Sen, 1982; Surty, 1983).

On the organisational dimension, role-efficacy has important moderating influence on dependent purposeful job-behaviour and independent variables such as demographic factors, organisational climate and role-stress. It shows remarkable impact in relation to demographic and organisational clusters. Its inclusion or exclusion brings about 50 per cent change in the coefficient of correlation (Das, 1984). Increased work related tension has negative correlation with overall role-efficacy. Personal attributes and job demographics have impact on role-efficacy (Sayeed, 1985). Operational and administrative roles, as also stations of posting have moderating impact on role-efficacy of police officers in Ireland (Moran, 1986). Conducive environment is reported to make leadership work which ultimately influences role-efficacy of organisational members and their productivity (Sayeed, 1992a). Strong linkage exists between role-efficacy and appropriate structure of position power/task structure (Sayeed, 1992b).

Work related tension has negative correlation with overall role-efficacy.

Pareek (1987, 1993) after review of researches conducted on role-efficacy recommended an audit on the process of role perception i.e. role-efficacy in different job settings and embark upon appropriate strategy to bring about a change in various segments of such perception through performance counselling and utility analysis. Most of the researches cited have been conducted on managers. Nevertheless, they demonstrate potentiality of role-efficacy in improving job behaviour actions of other job occupants. Pandey (1993a) conducted role-efficacy labs for motormen working suburban trains in Mumbai and found role-efficacy as means to bringing about a positive change in overall disposition to the job and the railway, and in preventing accidents for a period of two years (July, 1991 to July, 1993). In another study, Pandey (1998) found role-efficacy was determined by education and proper perception of signals. If role-efficacy labs are conducted on supervisors and managers along with workers, it may be possible to reduce the feeling of increased work related tension, bring about a change in organisational climate, improve work place relations, improve quality of work life, reduce accidents and increase productivity of the Indian Railways.

Hence an attempt was made to audit the role-perception of supervisors, diagnose weak and strong areas of role-perception, design and offer counselling at micro-level HRM. Utility of the intervention after 5 days training and after one year performance on the actual role has also been checked.

Methodology

Ninety one Supervisors/Safety counsellors served as sample for the study. 51 of them were working in Jhansi, Jabalpur, Bhopal, Bhusawal and Nagpur Divisions of Central Railway. They ranged in age from 34 to 57 years with a mean of 50.13 years and SD of 2.13 years. In experience they ranged from 1 to 23 years with a mean of 10.17 years and SD of 8.17 years. Majority of the subjects had studied up to Xth standard. Some of them had done three years diploma course in different disciplines like Civil, Mechanical and Electrical Engineering. Some had studied up to graduate and post graduate level. Some had acquired Law Degree also. The other sub group of forty subjects was working in Jaipur, Ajmer, Baroda, Rajkot, Bhavnagar and Mumbai Divisions of Western Railway. They ranged in age from 23 to 57 years with a mean of 49.17 years and SD of 7.8 years. In experience they ranged between 3 to 33 years with a mean of 14.6 and SD of 12.06 years. In education also they ranged between Xth standard and to graduate and post graduate standards. The sample covered five states i.e. Uttar Pradesh, Madhya Pradesh, Maharashtra, Gujrat and Rajasthan.

The subjects belonged to the traffic, loco, carriage/wagon, signal and civil engineering departments of two railways. All were connected with supervision of

various levels and types of workers of their discipline in train operation. While traffic supervisors were concerned with traffic staff i.e. Station Masters, Switchmen, Cabinmen, Pointsmen, Gatemen etc., the loco supervisors were concerned with Drivers, Asstt. Drivers, Shunters and other staff connected with driving the train engines. Workers in the maintenance of carriage and wagons, those connected with maintenance and up keep of signals and telecommunication system and staff connected with track maintenance were the other categories being supervised, which are quite sensitive areas where even small lapses result in accidents. Moreover, workers differed in regard to levels of education and job skill, perception and orientation.

Design

In each of the labs, the first unit of the programme focused on the psychological introduction of the participants among themselves. The group was divided into dyads (two persons), including persons from different places, branches and discipline. Each member of the dyad was asked to write his name, education, age, position, place of posting, and the name of the most liked person with reasons for his preference. The second unit of the programme was devoted to writing an essay on "My Role" with the following instructions "Think of your role, write about 2-5 pages on how you perceive your role, how you feel about it, and how you operate in this role. You may choose whatever aspects you think are relevant".

The third unit of the programme focused on filling of a questionnaire. It was a structured scale having twenty triad statements. The respondents checked on statement in each triad which most accurately described their role. Developed by Pareek (1980), the questionnaire has ten dimensions namely centrality, integration, pro-activity, creativity, inter-role linkage, helping relationship, super-ordination, influence, growth and confrontation. For each of the ten dimensions, there were two questions. A score of +2 was given for a positive statement, +1 for a useful statement, and –1 for a negative statement. Each triad had a pre-weighted score. Thus maximum score of +4 and minimum score of –2 could be secured by an individual on each dimension. The total of scores on 10 dimensions was taken as the role-efficacy score which could range between –20 and +40. Test-retest reliability of the test is reported to be 0.68, significant at .001 level (Sen, 1983). The validity of the scale for item total correlation for 20 Role-efficacy scale (RES) items for a total sample of 658 managers from 11 organisations individually ranged between 0.16 and 0.51. The mean correlated item total correlation for the 11 organisations ranged between 0.71 and 0.85 (Sayeed, 1983). Correlations between the role-efficacy and 10 constituent factors ranged between 0.15 and 0.72 for various groups of railway officials. Validity correlation of RES score with personal interview ranged between 0.57 and 0.73 (Pandey, 1992).

The fourth unit of the programme concentrated on concept formation and scoring of RES and discussion in the context of the values of the participants. The participants were asked to score their RES themselves and thereafter the papers were transferred to one another to check accuracy. In this session groups of persons scoring 4, 3, 2, 1, –1 and –2 were made to facilitate the discussion. The fifth unit formed the counselling session. In this session, ideas were generated from the group itself on each aspect and therefore the participants did not face any difficulty in accepting them.

Results

Table 1 presents the percentages of supervisors in two railways having positive perceptions and also percentages of supervisors with 25, 50, 75 and 100 per cent levels of distortions in each area of role perception. Areawise micro analysis is presented for diagnosing the present state of perception and distortion among participants.

Centrality: This dimension measures the perception of the importance of the role. Only 15.38 per cent participants of Central Railway and 9.09 per cent participants of the Western Railway had positive perception and the rest had distortions in their perception ranging from 25-100 per cent.

Integration: On the dimension of integration, where an individual feels that he has got the opportunity of utilizing his potential, knowledge, skills and experience in the job, approximately 77 per cent of the participants of Central Railway and 66 per cent of the Western Railway had a feeling of adequacy. Only 23 per cent of the job incumbents in the Central Railway and 34 per cent in the Western Railway had deficiency in various degrees. Deficiency upto the level of 25 per cent was found in 15.38 per cent participants in the Central Railway and 18.18 per cent in Western Railway. Deficiency up to the levels of 50 per cent, 75 per cent and 100 per cent was found in a very meagre percentage of participants.

Proactivity: On the dimension of proactivity i.e. taking initiative and action in advance, it can be seen that 23.07 per cent subjects in Central Railway and only 9.09 per cent subjects in the Western Railway had scored 4. While in Central Railway, per cent of the subjects requiring some intervention was approximately 77 per cent, the same in the Western Railway was found to be 91 per cent. Regarding degrees of deficiencies i.e. to

the levels of 25 per cent, 50 per cent, 75 per cent and 100 per cent, subjects in the Central Railway were 44.23 per cent, 9.6 per cent, 13.46 per cent and 9.6 per cent respectively, whereas the same in Western Railway were 52.20 per cent, 15.90 per cent, 6.80 per cent and 15.30 per cent respectively.

Table 1: Percentage-wise distribution of supervisors on dimensions of role efficacy

Dimension	Rly.	Rating Scores				
		4	3	2	1	Below 1
Centrality	CR	15.38	30.76	40.38	9.60	3.80
	WR	9.09	45.45	36.36	4.50	4.50
	Average	12.24	38.11	38.36	7.05	4.15
Integration	CR	76.92	15.38	1.92	5.76	0.00
	WR	65.90	18.18	4.50	4.50	6.80
	Average	71.41	16.78	3.21	5.13	3.40
Proactivity	CR	23.07	44.23	9.60	13.46	9.60
	WR	9.09	52.20	15.90	6.80	15.30
	Average	16.08	48.22	12.75	10.13	12.45
Creativity	CR	23.07	48.07	19.23	1.99	7.60
	WR	29.54	31.81	27.27	4.50	6.80
	Average	26..31	39.94	23.25	3.25	7.20
Inter-Role Linkage	CR	59.61	28.54	1.92	7.60	1.92
	WR	38.63	31.81	2.27	25.00	2.27
	Average	49.12	30.18	2.10	16.30	2.10
Helping Relations	CR	56.66	9.61	0.00	23.07	1.92
	WR	52.27	13.63	9.09	20.45	4.50
	Average	54.47	11.62	4.55	21.76	3.21
Super-ordination	CR	15.38	38.69	9.60	26.92	15.38
	WR	15.90	15.90	15.90	31.81	20.45
	Average	15.64	27.30	12.75	29.37	17.92
Influence	Cr	3.84	48.07	21.51	11.53	15.38
	WR	18.18	50.00	18.18	6.81	6.81
	Average	11.01	49.04	19.85	9.17	11.10
Growth	CR	28.84	36.53	18.23	13.46	1.92
	WR	34.09	36.36	22.72	4.50	2.27
	Average	31.47	36.45	20.45	8.98	2.10
Confron-tation	CR	67.30	19.23	1.92	7.69	3.84
	WR	72.72	18.18	6.81	2.27	0.00
	Average	70.01	18.71	4.37	4.98	1.92

Creativity: Approximately 23.07 per cent participants of the Central Railway and 29.54 per cent participants of the Western Railway perceived opportunity for creativity, however, nearly 77 per cent in the Central Railway and 70 per cent in the Western Railway required some intervention to use their creativity potential. In regard to deficiency to the levels of 25 per cent, 50 per cent, 75 per cent and 100 per cent there were variations between the two railways. Approximately 28 per cent of the participants of the Central Railway and 38 per cent on Western Railway required immediate counselling help.

Inter Role Linkage: This dimension measures the perception of interdependence with other roles. While 59.61 per cent participants of Central Railway were found in satisfactory state, in the Western Railway, it was only 38.63 per cent. There did not appear to be any significant difference between the two railways in regard to mild deficiency up to the level of 25 per cent. The per cent of participants requiring immediate attention in the Central Railway was approximately 10 per cent, whereas the same in Western Railway was approximately 29 per cent.

Helping Relations: This dimension measures the feelings of participants with regard to helping/taking help from, others. The percentage of participants having adequate perception were 56.66 per cent and 52.27 per cent on Central Railway and Western Railway respectively. Subjects having mild deficiency i.e. up to the level of 25 per cent were 9.61 per cent and 13.63 per cent. Subjects having major deficiency and requiring immediate attention was 24 per cent for both the railways.

Superordination: This dimension measures the perception that something beyond the regular call of duty is being contributed to the larger society and the nation. The percentage of participants having adequacy was approximately equal for both the railways and the same was found to be quite low. On this dimension 85 per cent subjects of both the railways needed immediate counselling help to boost their effectiveness. Nevertheless, there appears to be significant difference between the percentages of subjects having mild inadequacy on this dimension, as the percentages of such persons on Central and Western railways were 38.69 per cent and 15.90 per cent respectively. Percentages of participants requiring immediate attention were 52 per cent and 68 per cent for Central and Western railways respectively.

Influence: This dimension measures the perception of the individual towards own capacity in making an impact on others. Only 3.84 per cent participants of Central Railway and 18.18 per cent participants of Western Railway had adequacy on this dimension. No significant difference appeared to exist between percentage of subjects having mild inadequacy as the percentage for Central and Western railways were 48.07 per cent and 50 per cent respectively. However, there was significant difference between the percentages of

participants having major distortion in their perception – 48.42 per cent of the participants on Central and 31.80 per cent of the participants on Western railways required immediate attention.

Growth: Perception of opportunities to learn new things for personal growth on the job is measured by this dimension. Only marginal difference between the percentage of participants having adequacy on this dimension was noticed. Percentages of the participants on the Western and Central railways were 28.84 per cent and 34.09 per cent respectively. Approximately equal percentage was found to have mild deficiency up to 37 per cent in both the groups. Approximately equal percentage required immediate attention.

Macro-Analysis: In order to present an overall qualitative picture of role perception on both railways as a whole averages were worked out of the percents of the incumbents along three qualitative categories. Rating score of 4 was renamed 'Adequacy', 3 was 'Mild Inadequacy' and 2 and below 'Major Inadequacy'. Average of the percents of subjects of the two railways were worked out and are shown in Table 2.

Table 2: Percentage-wise distribution of supervisors along three qualitative classes of role-efficacy

Dimension	Adequacy	Mild-Inadequacy	Major Inadequacy
Centrality	12	38	50
Integration	71	17	12
Proactivity	16	48	36
Creativity	26	40	34
Inter-Role Linkage	49	30	21
Helping Relations	54	12	34
Superordination	16	27	63
Influence	11	49	40
Growth	32	36	32
Confrontation	70	19	11

It can be noticed that highest percentage of subjects i.e. 71 per cent were found to perceive adequacy in the dimension of Integration followed by 70 per cent in 'Confrontation'. The third high ranking percentage was found in the dimension of 'Helping relations'. The lowest percentage of subjects having adequacy (11%) was found to exist in the dimension of 'Influence', 12% in 'Centrality', 16% in 'Superordination' and 'Proactivity'. Percentages of subjects having adequacy in the dimensions of Inter-role linkage, Growth and Creativity being 49 per cent, 32 per cent and 26 per cent ranked in the middle i.e. at 4th, 5th and 6th position in the descending order.

Regarding the per cent of subjects having major inadequacies i.e. requiring immediate intervention, the highest per cent of subjects (63%) were found in the dimension of 'Superordination' followed by 50 per cent in 'Centrality', 40 per cent in 'Influence' and 34 per cent both in 'Creativity' and 'Helping relations'. In this hierarchy, 32 per cent for 'Growth', 21 per cent for 'Inter-role linkage', 12 per cent for 'Integration' and 11 per cent for 'Confrontation' came in descending order.

Discussion

The high percentage (71%) of supervisors having adequacy on the dimension of 'Integration' may be explained in terms of their long exposure to the organisation and majority of them working in the grade of Rs. 6500-10500 and Rs. 7450-11500 i.e. their earning per month coming to the tune of Rs. 10,000 to 15,000 excluding the travelling allowances etc. It gives support to the promotion policy of the railways for bringing effectiveness.

The high percentage of supervisors having adequacy on the dimension of 'Integration' gives support to the promotion policy of the railways.

The second highest i.e. 70 per cent of supervisors having adequacy on the dimension of 'Confrontation' supports the point put forth for the 'Integration' dimension. It also gives an indication about their readiness to face any challenge and about the assertive style being practiced by them in dealing with subordinates.

The third and the fourth highest per cent 54.6% and 49% of subjects on the dimensions of 'Helping relations' and 'Inter-role linkage' may be attributed to the inter-dependence of one department on the others. For example, when a train starts from a station, atleast 7 to 9 departments of the railway work together. Besides, the role incumbents have to be out of their headquarters, they have to help each other in job requirements as well as care for the family. The lowest percents of 11 per cent, 12 per cent, 16 per cent and 26 per cent on the dimensions of 'Influence', 'Centrality', 'Proactivity' and 'Creativity' are also attributable to the job requirements and lack of opportunity for creative work. On the dimension of 'Superordination' also, the per cent of subjects being only 16 per cent gives a hint towards prevailing neglect of the individual railways towards inculcating such a feeling in the workers.

The highest percents (63%) of the subjects having major inadequacies in the dimension of 'Superordination' and 50 per cent in 'Centrality' give a hint perhaps towards lack of programmes of awareness about ethos and social service being rendered by the railways. A sizable per cent i.e. 40 per cent of the subjects had major inadequacies in 'Proactivity', 'Creativity' and 'Growth' being indicator to lack of opportunities to the subjects in using their potentialities in the jobs.

In view of the majority of supervisors ranging from 43 per cent to 71 per cent having adequate perception of their role or role-efficacy in the areas of 'Integration', 'Confrontation, 'Helping relations' and 'Inter-role linkage', it becomes evident that they have developed involvement and commitment to the job and are in readiness to dedicate themselves towards the achievement of the goals of the organisation. However, majority of them ranging from 40 per cent to 63 per cent having major inadequacy in the areas of 'Superordination, 'Centrality', and 'Influences' put forth an urgent need for embarking upon role-intervention strategies by the organisation. How much social service is being rendered by the Indian Railways in general and in particular at the time of emergency, war, riots etc. is to be narrated in the interventions. The fact that almost 50 per cent of the supervisors feel inadequacy in the dimensions of 'Centrality', 'Superordination' and 'Influence' gives an empirical basis to the railway administration that even front runners are not aware of service being rendered by them for the welfare and development of the nation.

In view of the majority of supervisors having adequate role-efficacy in the areas of 'Integration', 'Confrontation, 'Helping relations' and 'Inter-role linkage', it becomes evident that they have developed involvement and commitment to the job.

Recommendations

In order to develop proper perception in the dimensions of role performance of incumbents, and to increase effectiveness in role perception ideas were generated from the subjects in group settings. Each participant having rating score of less than 4 on any of the dimensions was counselled in group setting to take action from his side in order to improve his perception. Number of participants in the group sessions was restricted to 10. Actions to be taken by the role incumbents in each of the 10 dimensions are summarised. These actions were decided by the participants themselves. Hence, adoption is supposed to pose no problem.

Centrality: Importance of the job of a supervisor in the organisational set up of train operation was discussed in detail. In the wake of ever changing technology, supervisors have to ensure correct compliance and reinforcement. Role-efficacy in the dimension of centrality can be increased if following actions are taken by the supervisors.

- Perception about the centrality of the job can be increased by self suggestion.
- Self-suggestion can be generated by acquiring knowledge and expertise in the skill of performing the job in the best possible and most effective way and demonstrating the same to the employees and facilitating adoption of new technology application.
- Helping workers in adopting the correct path can also increase the amount of centrality in one's mind. Being alert to helping workers and people in critical situations enhances image of railways.

Integration: A self revealing exercise of self analysis of one's Strengths, Weaknesses, Opportunities and Threats (SWOT) was carried out. Through this exercise, many possibilities for integration emerged.

- Feedback to be encouraged from supervisors, colleagues and subordinates in order to be aware of strengths and weaknesses.
- Experience is the best teacher. Therefore, one has to tell his experience to others and has to learn of experience of others.

Proactivity and Creativity: The process of acting being preceded by two more levels i.e. feeling and thinking was shown to them. Each of the participants agreed that most of his actions in the organisation are reactive. It was also explained that with the growing technological advancement and variety in organisational behaviour, organisations expect them to apply their past experience to current problems and to take action beyond immediate concern. The following emerged as suggestions:

- Developing the habit of thinking ahead i.e. anticipating what is likely to happen. Expectations of the superiors, colleagues and subordinates are always to be kept in the mind.
- Applying an analytical approach, using past experience in current problems, planning action in advance, trying out new ideas and taking feedback.

Inter-Role Linkage & Helping Relations: A supervisor has to have linkages at three levels: the higher level (with officers), lower level (with employees working under him) and horizontal level (with peers in own and other departments). These linkages have four important basis i.e. common goals, interdependency, empathy and crisis management. If through these linkages emotional linkage of empathy, support and sacrifice are created in the mind of employees, then quality of work life will be definitely improved. With regard to actions to be taken by the supervisors emerged:

- Planning new ways of inspection and counselling employees to correct erring behaviour.
- Developing new posters and slogans for increasing safety and efficiency.
- Being frank in expressing views in meetings.
- Communicating to other departments freely and frequently.
- Helping others, being open to help from others.

Superordination: Only a small percentage (about 15%) of the participants had proper perception on this dimension, approx. 85 per cent had distortion in their perception from 25 per cent to 100 per cent level. However, in group sessions, some of the participants spoke about how they are contributing to national and industrial development. On hearing such lectures by their peers, the participants with deficiency showed positive change in their outlooks. Several action suggestions were generated. Some of them are:

- Learning more about the corporate objectives of the railways and about the social purpose linking North to South, West to East for social and national development.
- Learning about the crucial role played by the railways at the time of wars, riots and other emergencies.
- Reading railway publications like Indian Railways Year Book etc.
- Identifying areas to contribute for cause of the society.

Influence & Growth: In order to bring about a change in the deficiency of perception about one's capacity to bring an impact on others and perception about coping with new things, group exercise was conducted. Persons who scored high i.e. 3 and 4 were found to have no inhibitions. A number of suggestions came out, some of which are:

- Being aware as to how much one has learnt from experience.
- Developing adequate competence in dealing with persons at higher, lower and equal levels.
- Being conscious of achievements.
- Developing self-monitoring system in the context of achievements in the two dimensions.

Confrontation: As Indian Railways is the biggest public sector organisation, style of management and leadership followed is of autocratic type; unless a supervisor has adequate assertiveness, he can not function well. It is evident that approximately 70 per cent of subjects had adequacy, 19 per cent had mild inadequacy and only 11 per cent had major inadequacies. For removing the inadequacies, the participants themselves suggested the following steps to be taken by them;

- Dealing directly with the subordinates and avoiding sending the report to higher ups.
- Studying the pros and cons of the problem before confronting.

Utility Analysis: The role-efficacy labs were organised as part of training programmes 'on counselling better' with the specific objective of bringing about a positive change in the role-perception of supervisors by diagnosing deficiencies in various dimensions of role-efficacy and counselling them towards correcting their erring behaviour. At the end of each training programme, each participant was asked a question in the feedback exercise, as to how he perceived the opportunities of his effectiveness in the job?. Almost 95 per cent of the participants expressed perception of greater opportunities than they had stated in the expectation scale before commencement of the course. Officers under whom they are working reported of there being positive change in the outlook and disposition to the job. Although it will be an over claim, it is a fact that this role efficacy exercise of supervisors might have indirectly contributed to achievement of safety shield of Indian Railways for year 1992-1993 and 1993-1994 by Western and Central Railways respectively.

Conclusion & Suggestions

Indian Railways is making tremendous progress in adoption of technology. However, unless adequate attention is paid to human resource management, expected progress can not be achieved. The results of the case study on a limited number of supervisors of Central and Western Railways gives an insight into the

probable benefit of role-efficacy interventions for railway supervisors. It also identifies weaker dimensions of role perception. There appears to be an urgent need to conduct such labs for all supervisors engaged in railway operations. Indian Railways may undertake the exercise of conducting this role-efficacy lab for managers, supervisors and workers simultaneously to derive perceptible benefit of the intervention on a trial basis. The stereotyped and traditional approach being adopted by the railways will not do. Conducting of such labs is likely to raise morale and motivation of the staff in addition to increasing productivity of the organisation.

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Feature

Global Warming: Threats & Challenges to Agriculture

Chellam Balasundaram, N. Manimekalai & P. Mariappan

Global warming has been observed to cause perceptible changes on the earth's climate and ecosystem. The article analyses its impact in the coming years, with special reference to agriculture.

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Green house effect or global warming is due to the anthropogenic emission of green house gases into the upper atmosphere (15-60 km above the earth) which heats up the earth. The concentration of carbon-di-oxide, the major green house gas has gone up from 311 ppm in 1957 to 338 ppm now. Carbon-di-oxide concentration has increased to 12 per cent between 1990 and 1995 (Fuller, 1997). It is estimated that for each ton of coal mined and used, 0.693 tons of carbon-di-oxide are pumped into the atmosphere, for crude petroleum it is 0.769 tons and for one million cubic meters of natural gas, it is 524 tons of carbon. Thus six billion tons of carbon is emitted due to anthropogenic activities per year. Methane is another potential green house gas emitted from cattle dung and water logged paddy fields. It is estimated that carbon-di-oxide accounts for 50 per cent of the warming effect, CFC 20 per cent, Nitrous Oxide 7 per cent, Methane 12 per cent and the rest is due to other trace gases (Stoel, 1998). Besides, the sun has a cycle of expansion and shrinking. Now it is in the expansion stage, exacerbating the warming effect along with the green house gases.[1] However, the same green house gases occurring in nature have kept the earth warm at global average of 15°C without which earth would have been a lifeless, barren and frozen desert like Mars. It is pertinent to point out that during ice age the mean global temperature was 10°C.

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1. Studies at high altitude laboratory in Colorado, USA; quoted in Citizens Report, 1982; p. 87.

Effects of Global Warming

The temperature change by 2020 will be +0.53°C and by 2050 it would be +1.16°C. The change would not be uniform throughout the globe. It will be about 2°C at about 40L (roughly near New York), 4.5°C at 60L and 10°C in Polar regions (IPCC, 1994).

Consequences

- A two feet rise in Sea level. 80 per cent loss of coastal wet lands in U.S.A. 20 per cent loss of inhabited lands in Egypt. Salt water incursion into coastal riverine deltas and into drinking water systems causing violent changes in economy and usability of shoreline area.
- Rapid melting of glaciers and decreasing smoke hours in some areas (Wang & Lewis, 1992; Monastersky, 1992)
- Tripling of warmer days above 35°C in mid latitude
- Pole ward spread of diseases: Eg: mosquito borne diseases
- Agricultural zones would change location
- An enhanced mean global hydrological cycle leading to more severe floods/droughts in some places (already 50 million people in the world are at risk due to floods. A 50 cm rise will make this 92 million. A one meter rise will make it 118 million)
- Loss of culture and civilizations

Globally each nation is aware of the need to curb the Green House Gas Emission. Developed countries have caused and continue to be the source of much of the emission. For instance, USA is 85 per cent dependent upon fossil fuels and a 20 per cent cut below 1990 emission levels, as tentatively fixed by the Rio Convention, 1992, would reduce its GDP by 1 to 2 per cent costing $1,00,000 per year. Hence, despite the Rio declaration signed by 2500 scientists, the Green House Effect is there still and meaningful enforcement is yet to take shape. Besides, there is a debate whether the developing countries should be exempted from such cuts on emissions. Indeed the developing countries object to any such cuts on carbon emission imposed on them and call this carbon colonialism since the carbon-di-oxide effect is essentially due to developed countries in the wake of industrialization. For instance, India ranks sixth in the total global carbon emission but in terms of per capita emission it is far behind (less than one metric ton when compared to the maximum emission of about 20 metric tons by USA (World Resources Report, 1994-95). Meaningful agreements are yet to be implemented. Dangers of such inaction will reflect badly on developing economies where 90 per cent of the future population increase is projected. For instance, with the already strained resources, India with one-fourth of world's land, has to support one-sixth of the world's population, half of its buffaloes and over one-seventh of its goats and at the foodgrains front, the cereal production has to be increased to 220 million by 2001 to feed one billion population from the same amount of land which produced only 58 million tonnes of foodgrains in 1950-51.

Developed countries have caused and continue to be the source of much of the emission.

The existing studies through computer simulated modelling have taken into account the following parameters: climatic conditions, changes in the level of fertilizer and irrigation, changes in crop varieties, strategies to ameliorate the estimated losses, greater water use efficiency and effect of increased carbon-di-oxide levels, carbon-di-oxide fertilisation effects on crop growth and yield.

However, the models might have missed an extraneous variable. Terraria studies with increased carbon-di-oxide levels have also been attempted. These studies reflect on the harvestible yield and yield quality. However, how these effects will interact with the other environmental stresses is yet to be ascertained. For instance, increased precipitation will lead to increased evapo-transpiration and drought. Increased carbon-di-oxide will have a positive effect as a fertilizer promoting photosynthesis. But foliage with high carbon content and less nitrogen content are not preferred by herbivores. Changing climate may shift the distribution of land across several agro-climatic land classes. Besides, the response of the eco-system is also not known, since some of the biologically rich tropical eco-systems are also fragile.

Salient Findings of the Models on Agriculture

The global models on agriculture and climate change (Reilly, 1994; Reilly et al., 1993; Reilly & Hohmann, 1993; Rosenzweig and Parry, 1994) predict that the already leading global grain exporters stand to benefit with 'adaptations' from higher prices for their agricultural exports. Such agricultural impacts will be-

Global models on agriculture and climate change predict that the already leading global grain exporters stand to benefit with 'adaptations' from higher prices for their agricultural exports.

come significant by 2060. The global food production will marginally benefit for the next 50 to 60 years but the regional disparities in food production (the developing economies will be adversely affected) will lead to violent upset in food balance. However, modelling cannot be perfect. Some of the uncertainties are:

- The models so far do not agree on the direction of change in precipitation nor on the magnitude of change.
- Whether the positive effect (for instance 20-40 per cent increase in yield for C3 crops at a 600 ppm ambient concentration of Carbon-di-oxide) is transferable to field conditions in view of weed competition, pest resurgence, soil degradation etc.
- Uncertain timing of the effect. Will it be more in winter or summer?
- Changes in other resources like land and water use.
- It is difficult to predict how the clouds will respond to warming. Clouds reflect sunlight into space cooling the earth but they reflect heat radiated from earth (Ramanathan et al, 1989). The number of clouds, their location, altitude and reflective properties due to global warming cannot be predicted.
- Earlier models did not account for: stratospheric cooling due to ozone depletion, due to CFCs in lower atmosphere, where ozone is a green house gas or sulfate and smoke aerosols which also cool the earth due to reflective properties and shading effect (Ramaswamy et al, 1992).

Agricultural Policy Implications

No one anticipates the sudden imposition of an International Agreement to hold trace gas concentration at their current levels. Therefore, global agriculture will be forced to adapt to some amount of climate change. In this context:

- Farmers in less affected countries would sell produce at higher profits to consumers in worst affected regions. Thus strengthening of GATT is essential to provide important flexibility in trade to adapt to climate change.
- Strategic investments in agriculture has to be examined in view of changing agronomic conditions locally and globally.
- To adapt to changing situations, farmers have to be trained and educated to cope up with crop diversification and to ensure against financial risk.
- Subsistence or marginal farming has to be given extra care since the risks in such systems are starvation and malnutrition.
- Though the results of the various models differ in projections, they invariably agree that the developing countries will be more affected.
- Climate will not be the only factor that changes after 50-75 years. New crops and technologies will emerge, local demands will change as incomes rise and input-output prices will change. Those with good farm networks can effectively deal with the situations (Ruttan, et al, 1994).
- Farming strategies would have to be re-examined since yields of all crops may be changing simultaneously
- With the changing climatic conditions, choosing suitable sites for different crops would also be a priority.
- The cost benefit analysis for mitigation procedures should also be made available. Liberal financing by International Agencies must enable participation of global members.

Unchecked climate changes over long term will lead to mass migration, political changes, economic chaos and agricultural disruptions.

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Hunger, Vulnerability & Social Change

International food prices continue to decline for the past 20 years. But one billion people earn one dollar a day and are unable to buy food. The result is

lower prices and continued hunger. Some of the problems are listed in Table 1. Climate change is strongly linked to hunger and famine (Kates & Chen, 1994). The current global capacity for food production is adequate to avoid famine and malnutrition, but famine occurs because available food does not always get to those most in need. People do not get access to food due to wars and political upheavals. However, this could be short-term problems whereas agriculture affected by climate would be a long term problem aggravating the famine potential in some areas. Thus with the projections that global agriculture will not be affected over the next 50-75 years, the famine and chronic hunger in the already preventable areas will further worsen.

Table 1: Problems of Today

One-sixth of the human family goes hungry and malnourished.
1 billion people live on less than a dollar a day, most of them lack security to access to food, the most basic of basic needs.
About 800 million people are food insecure.
1 billion people do not have access to clean water.
1.7 billion have no access to sanitation.
Those last two figures together result in 2 to 3 million eminently avoidable infant deaths a year.
185 million children under the age of six are seriously underweight.
The gap between rich and poor continues to widen. The share of global income obtained by the world's poorest 20 per cent has dropped from 2.5 per cent in 1960 to 1.3 per cent in 1990.
Hundreds of millions of poor farmers have difficulty maintaining the fertility of the soils from which they eke out a meager living.

Source: A 2020 Vision for Food, Agriculture, and the Environment. International Food Policy Research Institute, Washington DC.P.131.

The scientific consensus on global climate change is represented by the findings of the Intergovernmental Panel on Climate Change (IPCC), which brings together several hundreds of the world's leading atmospheric scientists under the auspices of the World Meteorological Organisation and the United Nations Environment Programme. What is that consensus in practical terms? Jerry Mahlman, director of the Geophysical Fluid Dynamics Laboratory of the U.S. National Oceanic and Atmospheric Administration, has attempted to answer that question (Table 2) by restating IPCC consensus in the following terms: Virtually certain (nearly unanimous agreement among scientists and no credible alternative view), very probable (roughly a 9 out of 10 chance of occurring), probable (roughly 2 out of 3 chance of occurring), and uncertain (hypothesized effect for which evidence is lacking).

Table 2: Degree of Consensus on Various Climate Change Issues

Issue	Statement	Consensus
Basic Characteristics	Fundamental Physics of the green house effect	Virtually certain
	Added green house gases add heat	Virtually certain
	Greenhouse gases increasing because of human activity	Virtually certain
	Significant reduction of uncertainty will require a decade or more	Virtually certain
	Full recovery will require many Centuries	Virtually certain
Projected effects by mid-21st Century	Large stratospheric cooling	Virtually certain
	Global-mean surface precipitation increase	Very probable
	Reduction of sea ice	Very probable
	Arctic winter surface warming	Very probable
	Rise in global sea level	Very probable
	Local details of climate change	Uncertain
	Tropical storm increases	Uncertain
	Details of next 25 years	Uncertain

Source: World Resources: A Guide to the Global Environment.

Conclusion

Intergovernmental Panel on Climate Change (IPCC), 1994 and a number of other International Organisations have pointed out that global warming will be real. However, consensus on how to achieve reduction in green house gas concentration is yet to be assured at. Even if it is accepted by governments, it would be difficult to monitor. It is suggested that a corpus fund be created to save the vulnerable population from hurricanes and storms. But it would be difficult to separate the natural calamities from the climate induced ones. So far the tested models have predicted that global agriculture will marginally stand to benefit due to global warming over the next 50-75 years. However, the worst affected will be the developing economies due to vagaries in food production, which fact cautions us to beware of the ill-effects of green house effect.

It is suggested that a corpus fund be created to save the vulnerable.

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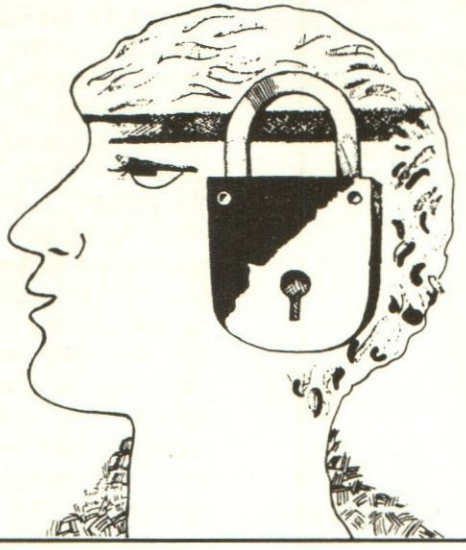
MANAGEMENT THOUGHTS : BY PRAMOD BATRA

Nothing dies faster than a new idea in a closed mind



There is a Chinese saying:

"You can't pour fresh hot tea into a cup of stale cold tea."

And there is a Zen story in which an American professor went to the Zen master to know all about Zenism. The master started pouring tea and after a while it started overflowing the cup. The American shouted, "Master, master, no more will go in the cup." The Master replied, "Yes, like this cup your mind is overflowing with your own ideas. You must empty your mind a little for the new ideas to come in."

Well, unlock your mind – rather throw away the lock! Keep on using your mind so that more ideas can come in – fresh and new!

□ Think Inc., Batra

Feature

Public Enterprise Reforms in India

B.S. Ghuman

Public enterprise reforms in India have completed eight years. An analysis of the reforms suggests a correlation between government change and, the type of aims and reforms. During Congress rule (July 1991 – May 1996) the reforms aimed at raising of revenue for reducing fiscal deficit and keeping government at an arm's length. The United Front Government (June 1996 – March 1998) having a left party as coalition partner and support of other left parties envisaged empowerment of profit earning public enterprises (under Navratna and Miniratnas Packages) as vehicle for making them global and national players. Public enterprise reforms witnessed a turning point during Bhartiya Janata Party led Government (March 19, 1998 and continuing). During this phase aim of reforms is raising of resources, and paving the way for privatisation and exit policy.

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Public enterprise reforms in India have been one of the most important variants of liberalisation policy. The first major policy decision to reform public enterprises in the country was taken on July 24, 1991 and since then the process is on. Though the reforms are gradual for all intents and purposes the process seems irreversible. Since July 24, 1991 almost all the major political parties have either ruled the country or have extended support to the government from outside. Inspite of their differences across the type, sequencing and pace of reforms, none of the political parties has sought the reversal of the reforms.

The eight-year period of public enterprise reforms can be divided into three phases on the basis of type and aims of the reforms. It is postulated that there seem to be links between government change and the type and aims of the reforms. Each phase, thus, co-terminates with the tenure of the government. The first phase covers the period from July 1991 to May 1996. During this period a centrist party, namely, Congress (I) ruled the country. The second phase falls over a period of 1 year and 8 months (from June 1, 1996 to March 18, 1998) during which the United Front (UF) led coalition government was in power at the national level. The UF government had one left party as a partner in the cabinet and the support of other left parties from outside. The third phase of reforms starts from March 19, 1998 and is continuing. During this phase Bhartiya Janata Party (BJP – a party having considerable influence of the New Right Philosophy) and its allies consisting of mainly regional parties are in power at the central level. The objective of this paper is to analyse phase wise public enterprise reforms in India.

First Phase: The Foundation Phase

During the first phase, four types of reforms were announced in the New Industrial Policy 1991 (NIP, 1991). These were dereservation i.e. opening of many areas to the private sector which were hitherto monopoly of the state sector; disinvestment; introduction of performance contract system (known as memorandum of

Table 1: Disinvestment Public Enterprises (PE) Shares between 1991 and 1995 (First Phase)

Year	No. of PE's Involved	No. of Shares Sold (Millions)	Amount Realised (Rs. Million)	Average Price Per Share (Rs.)	Amount Targeted (Rs. Million)	Mode of Disinvest-ment	Minimum Bid (Rs. '000)	Open to
1991-92	30	872.10	30,380	34.85	25,000	Bundling	50,000	Public Sector, Financial Institutions and Mutual Funds
1992-93	16	449.04	19,125	42.56	35,000	Tender	25,000 & 1,000	In addition general Public
1993-94	7	113.70	22,910	201.50	25,000	Tender	100	In addition Foreign Institutional Investors (FIIs)
1994-95	12	87.00	29,193	301.01	40,000	Tender	25	In addition Non-resident Indians (NRIs) and Overseas Corporate Bodies
1995-96	4	15.30	1,686	110.20	70,000	Tender	25	As Above

Source: Economic Survey; Department of Public Enterprises (Finance Division), Government of India; and the Economic Times.

understanding–MOU) on a larger scale; referring of sick public enterprises to the Board for Industrial and Financial Reconstruction (BIFR) with a view to explore the possibility of rehabilitation or closure of the enterprise. The aims of the reforms were to raise revenue to meet fiscal deficit, keep government at arm's length, and promote business like culture in the public enterprises.

During this phase Congress (I) a centrist party constituted the government at the national level. The experience of this phase reveals that dereservation and disinvestment were implemented more seriously. Prior to NIP, 1991 around 17 industries were monopoly of the state sector. Their number was reduced to 6 which cover defence products, atomic energy, coal and lignite, mineral oils, railway transport and specified minerals. This style of privatisation has not been met with much resistance in India.

Prior to NIP, 1991 around 17 industries were monopoly of the state sector. Their number was reduced to 6 which cover defence products, atomic energy, coal and lignite, mineral oils, railway transport and specified minerals.

In India traditionally most of the public enterprises were fully owned by the government. Disinvestment programme was initiated with a view to: raising of resources to meet fiscal deficit; encouraging wider public participation including that of workers; penetrating market discipline within public enterprises; and improving performance. The government had completed eight rounds of disinvestment. The first round was completed in December 1991 and the eighth in November, 1995 (see Table 1). The government had raised around Rs. 100 billions through disinvestment against the target of Rs. 195 billions. However, the government has not succeeded in tapping the full potential of disinvestment (see Table 2).

Table 2: Extent of Undervaluation of Disinvestment Proceeds

(Rs. billion).

Year	Potential Proceeds	Actual Proceeds	Revenue Lost
1991-92	115.49	30.38	85.11
1992-93	26.17	19.12	7.05
1993-94	23.83	22.92	0.91
Total	165.49	72.42	93.07

Source: Economic Surveys; Department of Public Enterprises (Finance Division), Government of India; and the Economic Times (8 & 14 December, 1995).

Lack of strategy, absence of systematic efforts to restructure and prepare undertakings for disinvestment; the arbitrary selection of companies for disinvestment (without consulting them); a highly secretive process; lack of objective in the methods of valuation of shares; lack of incentives for companies (in the form of ploughing back a percentage of the proceeds of disinvestment) to participate enthusiastically in disinvestment programme, limited competition; the lack of institutional

arrangements to oversee the disinvestment process and the lukewarm response of the private sector resulted in distress sales of public enterprise shares and under-realization of proceeds (CAG 1993; Mishra et al, 1995; and Ghuman, 1997).

Lack of strategy, highly secretive process, lack of objective valuation of shares, and the lukewarm response of the private sector resulted in distress sales of public enterprise shares.

The government mainly implemented the disinvestment programme to raise resources for bridging fiscal deficit. It has almost neglected the other objectives of disinvestment, namely, wider public participation particularly by workers, the introduction of market disciplines and performance improvement. Partly because of government policy, public financial institutions have emerged as the key players in the disinvestment process. The general public could not buy shares of public enterprises on a large scale mainly because of prescribed minimum bid ranging from Rs. 25 million to Rs. 25,000. In a country like India, with its glaring income inequalities and with one third of the population below poverty line, it seems difficult to move towards the objective of wider public participation through a minimum bid well above the resources available to common citizens. Stray cases of offering shares to employees have been reported. Whenever shares have been offered to employees, the disinvestment process has been concluded smoothly. Mainly due to limited disinvestment and that too monopolised by the public sector financial institutions and mutual funds, the penetration of market discipline into public enterprises has not been attained. Disinvestment has mainly been confined to profit-making units. However, this process of disinvestment has not resulted in further noticable improvements in the physical and financial performance of public enterprises (The Tribune, November 10, 1995; Dhameja & Sastry, 1998).

The MOU system envisaged granting of operational autonomy to the management and in return making it accountable through a contract system with a view to improving performance of public enterprises. The experience, however, suggests that both autonomy and accountability were not implemented in letter and spirit. The MOU system virtually emerged as another instrument in the hands of Administrative Ministry to control the management (Rao, 1993; Macus, 1994). During the first year of reforms (i.e. 1991-1992) as many as 71 public enterprises signed MOU. Their number increased to 104 in 1995-96–the terminal year of the first phase. Out of these, 51 were rated excellent, 51 very good and 2 poor (see Table 3). Inspite of the impressive performance rating under the MOU system, it hardly had any positive impact on profitability and total factor productivity (World Bank, 1995; Mishra, 1999). The poor performance of public enterprises measured with the help of alternative indicators (i.e. profitability and total factor productivity), suggests the in-built weaknesses of the MOU system. First, in the absence of benchmarking, target setting is reported to be soft (World Bank; 1995; Mohanty, 1994). Secondly, negotiation on the MOU target setting took so long that the targets were set to be the same as actual performance (World Bank; 1995; Mishra, 1999), and resulting in an 'excellent' performance rating.

In the absence of benchmarking, target setting is soft in the MOU system.

Table 3: Memorandum of Understanding (MoU): Key Figures

	No. of MoUs signed	A (Excellent)	B (Very Good)	C (Good)	D (Average)	E (Poor)
1991-92	71	31 (44)[4]	25 (35)	11 (15)	4 (6)	0 (0)
1992-93	98[1]	34 (35)	35 (36)	16 (17)	10 (10)	2 (2)
1993-94	101[2]	46 (46)	29 (29)	13 (13)	10 (10)	2 (2)
1994-95	99[3]	39 (49)	25 (32)	6 (8)	7 (9)	2 (2)
1995-96	104	51 (49)	51 (49)	–	–	2 (2)

Notes: 1. Grading information is available only for 97 PSEs.
2. Grading information is available only for 100 PSEs.
3. Grading information is available only for 79 PSEs.
4. Figures in parentheses are percentages.

Source: Department of Public Enterprises, Government of India, Annual Reports, MoU Newsletter and other documents, New Delhi.

In case of sick units, no headway had been made during this phase except setting up of a National Renewal Fund (NRF) to protect the interest of workers. The primary aim of NRF is to finance retraining, redeployment and counseling of dislocated workers. However, in terms of allocation of funds, this aspect had received only lip service. A major part of NRF is being spent to meet voluntary retirement obligations. About 75,000 workers mainly from the textile units sought voluntary retirement under VRS, a large number of

whom had high productivity and efficiency (Macus, 1994).

Though the first phase is characterised as a phase of limited achievements, this phase succeeded in laying down the foundations of reforms and therefore, it can be termed as the 'Foundation Phase'.

Second Phase: The Phase of Empowerment

During the second phase, along with earlier reforms, the government took up four new initiatives. These included granting of operational autonomy to giant public enterprises; professionalising the institution of board of directors; drastic reduction in the number of government guidelines to be compiled with by the enterprises; and setting up of the Disinvestment Commission. The aims of these reforms were to empower giant public enterprises so that they could establish their supremacy in global as well as national markets and administer the disinvestment programme through an institutional mechanism.

Second phase reforms included granting of operational autonomy to giant public enterprises and setting up of the Disinvestment Commission.

United Front led coalition government having the support of left parties was in command in India during the second phase. Granting of operational autonomy initially to 9 giant public enterprises on the basis of highest profitability and size of capital and later on to two more enterprises (termed as *Navratna Package*) is the most important initiative of the phase. Under this package, the government announced to grant autonomy to these undertakings in six major areas such as capital expenditure, organisational restructuring, personnel policy, technical joint ventures, financial joint ventures and borrowings. The aim of autonomy package was to enable these 11 top public enterprises to become giant players in the international market. At a later stage, it was announced that this scheme would cover additional 97 profit earning enterprises (termed as *Miniratnas*). The aim of *Miniratna* package was to enable these enterprises to become big players in the domestic market. The experience of this phase shows that the empowerment initiative to these select undertakings (*Navratnas and mini Navratnas*), remained limited upto the institution of board of directors. It has, however not percolated down to the middle and lower levels of management and as a consequence the empowerment packages have not translated into much at the ground level (Hakeem, 1999). The empowerment initiative faced serious problems even at the government and board interface level, as the political bosses and top bureaucrats have not got adjusted to decentralising and delegating decision making authority to the public enterprise (Tandon, 1999; The Economic Times 6 July 1999).

In the past, public enterprises in India were highly regulated. There were around 900 government guidelines which administered the behaviour of public enterprises. During the second phase of reforms, the government, on the basis of Vittal Committee Report, abolished as many as 696 guidelines, retained 105 and modified 25. This initiative has largely liberated the public enterprises from the stranglehold of bureaucracy. Another step towards empowerment was the restructuring of two top level undertakings namely National Thermal Power Corporation (NTPC) and Bharat Heavy Electricals (BHEL) by nominating part-time non-official experts as directors.

The Disinvestment Commission was set up on August 23, 1996. The major functions of the Commission include drawing up a comprehensive overall long term disinvestment programme, determining the extent of disinvestment, recommending suitable techniques of disinvestment, suggesting a mix between primary and secondary disinvestment, supervising the overall sale process, selecting financial advisors and ensuring employee participation in the shareholding of the enterprises, etc. The commission has done commendable job by covering almost all facets of disinvestment and corporate governance in its seven reports submitted during this phase. The government referred 50 central enterprises to the Disinvestment Commission. Out of these, 7 were withdrawn. The Commission, left with 43 undertakings submitted recommendations for 41. It recommended no disinvestment in case of core public sector enterprises; upto 49 per cent disinvestment in case of semi-core enterprises; and upto 100 per cent disinvestment in case of non core undertakings. The Commission has further suggested strategic sale as mode of disinvestment in 18 cases out of 41; trade sale in case of 6 undertakings and partial sale of equity in 5 cases. In case of one, no disinvestment has been suggested. Disinvestment has been recommended to be deferred in 7 cases; whereas closure/ sale has been advised in 4 cases. Unfortunately most of the recommendations of the Commission remained either unattended or were opposed. In the beginning of 1998, the powers of the Commission were trimmed drastically and its status was merely reduced to be an advisory body. The Administrative Ministry, employees and interests groups were the major stumbling blocks in way of ac-

ceptance and execution of the recommendations of the Commission (Ghuman, 1998). During this Rs. 3900 million was realised through disinvestment against the target of Rs. 50,000 millions. Global depository receipt (GDR) was adopted as the mode of disinvestment.

Third Phase: The Threshold Phase of Privatisation

This phase is characterised as a phase of policy decisions about privatisation of select undertakings, buyback and cross holding of shares; downsizing; professionalizing the boards; and closure of select sick units. The major aims of these measures were raising of resources to reduce fiscal deficit; shedding of manpower and paving the way for privatisation. During this BJP (a party following economic policy having proximity to the New Right thinking) and its allies consisting of mainly regional parties are in power at the central level.

Third phase is characterised as a phase of policy decisions about privatisation of select undertakings, buyback and cross holding of shares; downsizing; professionalizing the boards; and closure of select sick units.

The experience of this phase indicates that like earlier phases, raising of revenue through disinvestment for reducing fiscal deficit was among the major concerns of the government. Owning to bearish trend in the stock market, the government allowed six cash rich public enterprises to buyback their own shares or sell shares to other public undertakings. The government through this strategy succeeded in raising resources to the tune of Rs. 51.90 billion. About Rs. 10 billion through GDR route was also mopped up by the government. The targeted amount of disinvestment, during the third phase, was Rs. 50 billion.

With a view to shed manpower, voluntary retirement scheme (VRS) was extended to marginally profit making units. Earlier VRS was designed for the employees of sick units. It is however feared that voluntary retirement under VRS would be sought only by the workers having high productivity and efficiency in the marginally profit earning undertakings, leaving behind less productive and inefficient work force. This may result in pushing the marginally profit earning undertakings towards loss making trap. Another landmark decision of this phase is the winding up of 8 chronically sick units with liberal VRS package. Nomination of experts as part-time non-official directors on the boards of five top public enterprises also took place during the third phase of reforms.

Privatisation was not explicitly mentioned in the NIP 1991 and other official documents of phase one. The reference of privatisation did appear in one of the federal budgets during second phase particularly relating to the insurance sector, which was resisted by the left parties supporting the government. During the third phase, however, privatisation has appeared consistently in the policy documents, particularly the central budgets. The Finance Minister in the recent budget specifically mentioned privatising non-strategic public enterprises. The Finance Secretary also mooted the idea of privatisation through special purpose vehicle (SPV) somewhat patterned on the Malasiyan model. The chairman of the Disinvestment Commission has also proposed the idea of setting up of a National Shareholding Trust for privatisation. The government in June, 1999 announced privatisation of Indian Airlines. The President of India, however, did not allow the caretaker government to implement the programme as according to him, it is a major policy decision which may only be taken by a duly elected government. Recently, the Cabinet Committee on Disinvestment has announced privatisation of India Tourism Development Corporation (ITDC). In case of 12 public enterprises, merchant bankers and consultants have been appointed for offloading up to 74 per cent of their equity. The enterprises include Praga Tools, Bharat Heavy Plate and Vessels Ltd., Bharat Pumps and Compressors Ltd., Hindustan Cables, Scooters India Ltd., National Industrial Development Corporation, Bharat Leather Corporation, Bridge and Roof Company Ltd., Tungbhadra Steel Products, Hindustan Paper Corporation, and Engineering Products India Ltd. (The Economic Times, 6 August 1999). Though no tangible achievement has been experienced on account of privatisation, yet during this phase the government has considerably succeeded in moderating the opposition to privatisation programme particularly in areas which are non-strategic in nature. The BJP led coalition government has assumed office again at the Centre on October 13, 1999 after the recently concluded elections. The Finance Minister Mr. Yashwant Sinha immediately after resuming office made position about privatisation very clear by stating, "I have used the word 'privatisation' in my

Finance Minister in the recent budget specifically mentioned privatising non-strategic public enterprises.

budget. I don't consider it to be a dirty word. I am not fighting shy from privatisation. We will privatise PSUs and we will evolve a policy for speedy privatisation" (The Economic Times, October 15, 1999, P4). It is relevant to mention here that the BJP led coalition Government has comfortable majority in *Lok Sabha* (the Lower House of the Parliament) and hence would be likely to press upon the implementation of its agenda of second generation economic reforms including privatisation. The BJP led state governments have already implemented the privatisation programmes in the States ruled by them, particularly in Uttar Pradesh and Himachal Pradesh.

Conclusions

The Indian experience of public enterprise reforms gained particularly during a single political party government and two coalition governments throws up many issues. First, the reform process initiated since July 24, 1991, though gradual seems irreversible. Secondly, starting with limited reform measures, their number has multiplied during different phases. Partly fast changes in political regimes at the national level attribute to the multiplicity of reforms as one finds correlation between government change and the type and aims of reforms.

Thirdly, limited success in case of disinvestment and abolition of monopoly status of public enterprises has been achieved during the first phase. Empowering the boards of directors and deregulation of public enterprises by reducing the number of guidelines are worth mentioning features of the second phase. Policy decisions concerning privatisation of non core sector units, cross holding of shares, professionalising the board of directors and winding up of select sick units are the landmarks of the third phase. Fourthly, major stumbling blocks in the way of reforms are Administrative Ministries, employees and interest groups. Lastly over a period of eight years, the reforms after covering many areas seem to be on the threshold of privatisation. The Bhartiya Janta Party and its allies have been building a case for privatisation of select public enterprises. Other political parties, particularly leftist political parties, are likely to oppose privatisation.

Major stumbling blocks in the way of reforms are Administrative Ministries, employees and interest groups.

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Feature

Quality Audit in an Electrical Company—A Case Analysis

Rajesh Kannan, A. Dixit Garg & Jaideep Gupta

Because awareness of quality among customers is increasing at a rapid rate, quality has become the qualifying factor. Keeping this under consideration, a case study has been conducted in an electrical company.

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Quality is a relative term and is generally used with reference to the end use of the product (Mahajan, 1998). Quality of a product is nothing but its usefulness for the intended purpose (Samat, 1987). In today's dynamic market, quality has become an imperative to withstand competition (Seth, et al, 1995). Companies have to improve quality to bring the customer back (Feingenbaum, 1986). Market pressures are forever mounting creating new challenges at the workplace. There is always a good inventory of problems that need solution fast.

Keswani and Lakhe (1996) concluded that improvement in quality by reducing the number of defectives is a goal for every organisation. However, reduction of demerits requires additional investment. But by using Taguchi techniques, this can be achieved without much additional investment. Nitin Seth and Deshmukh (1995) suggested some methods for quality improvements in a medium scale industry by a case study, where the workplace problems were solved by Quality Control tools. Smart problem solving can be adopted in organisations. SMART stands for "Special Methodology Applied to Repetitive Troubles". It is based on Japanese Quality Control problem-solving approach effectively applied in several Indian companies.

A case study was conducted in a company which is one of the top 5 in India in electrical equipment manufacturing sector. The group is a worldwide leader in power generation, power transmission and distribution and rail transport and has significant presence in Industrial equipment and shipping markets with sales around 9.4 billion. All of these are supported by a worldwide corporate network present in more than 60 countries. In India, it has several operating groups under the transmission and distribution sector, such as Protection & control group, Transformer group, Rotating Machines group, and Switch gear group. Commitment to quality and adherence to quality systems are

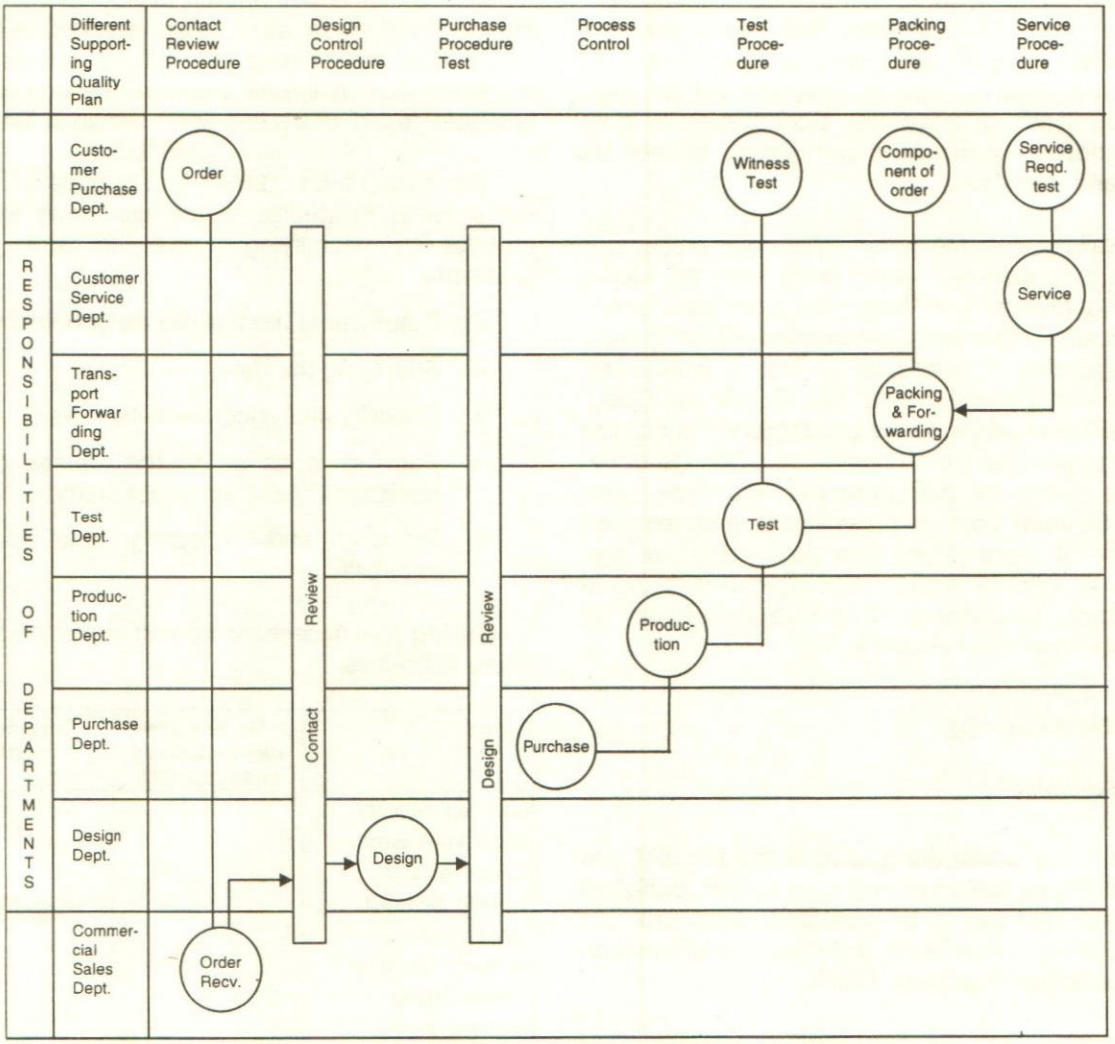

Fig. 1. Responsibilities of Departments

reflected in the notching up the prestigious ISO 9001 certification to its entire unit of product groups. With seven manufacturing locations, a nation-wide network of sales offices, 5000 employees and a turn over of Rs. 400 crores, the company continues to take the power engineering industry to newer heights.

The Protection and Control group (P&C) in India constitutes two business units with the Relay and Control panel units having their operation in Pallavaram, Chennai. The relay unit was established in the early sixties at Pallavaram, Chennai, to cater to the requirements of Indian industry for high quality safe relays. Although only a few types of electromechanical relay were being manufactured in the beginning, today this unit manufactures more than 150 types of relays from electromechanical to static relays, disturbance recorders and programmable equipment for relaying and measurement. The control panel unit has one of the largest assembly lines of its kind in India. The unit's product range covers protection and control panels for generators, transformers and power systems including industrial controls and railway traction switching control assembly. In Common Disk General (CDG) Cell, Relays are manufactured as well as exported with full/complete package. Basically these relays work under current, and are used to prevent equipment from over current or short circuit, with wide applications in circuit breaker, switch gear, transformer etc.

The company has a quality plan which sets out the quality practices, resources and activities to be followed to meet the quality requirements for the projects, products or contracts specified. This has been prepared for Standard Reference of Disc Relays too. The quality plan has been produced for control and information purposes. It provides a mechanism to relate the generic requirements of ISO 9001 to the specific requirements of protective and timer relays. The quality manual contains the company quality policy, specifications relating

the company systems to ISO 9001 and management organisation chart. The company also has documents that define all Specifications, Procedures, Codes of practices, Inspection Schedules, Purchase Specification and Development procedures etc. Documents are available for inhouse examination and copies cannot be produced and supplied.

Full details of documentation for specific projects or products are contained in paper work such as: Model List, Drawing, Material List, Wiring Diagram, Manufacturing Specification, Process Specification, Work instruction, Inspection schedule, Test instruction, Commissioning Instruction and Test Certificate. Documents detailing changes to the production process are Temporary departures from drawing and Change drawing notices. Most of the processes are now computerized. So hard copy of these documents may not be available at work place. The documents are distributed to all departments in accordance with document control procedures. The responsibilities of departments have been shown in Fig. 1.

Research Methodology

Problem Identification

In order to improve the quality of the product, the problem has to be identified and then solved. Sufficient and accurate data has to be collected. Basic problem in quality control is that of turning data into information that causes action (Harrison, 1986).

In this study, data was collected from Verification After Test (VAT) sheet or check sheet for CDG 56 type relay for August, 1999. In August, 1999 three types of relays were manufactured, namely CDG 16, CDG 36, and CDG 56. Among these, CDG 56 contains sufficient amount of data to analyze the defects.

Verification after Test (VAT)

Purpose	:	To systematize any formal verification activity after final testing of relays
Scope	:	The procedure is prior to prepackaging for verification of quality after testing
Responsibility	:	VAT cell reports to the Head
Procedure	:	After completion of all assembly activities, the relays are submitted for final inspection and testing at the test area.

In this VAT sheet various defect codes and defect ratings are given for each defect description and defect class. After determining the various causes for trivial problems from Ishikawa diagram, the optimal solution has been found which has been shown in Table 1.

Stephen (1965a, 1965b) had suggested six simple steps useful in studies of manufacturing and service process for identifying, correcting and preventing problems:

- Determining the magnitude of defectives
- Stratifying the data
- Critically analyzing the defectives
- Forming ideas as to the causes of the undesirable conditions under study
- Planning and collecting data for process capability

Taking the necessary corrective action to prevent future difficulties.

Defect	No. of times Defect-occurred in August 1999	Total number of Defects
Incorrect Assembly	I	1
Paper Work Error		
Crimping Joint		
Printing Incorrect		
Open circuit		
Contact Alignment	I	1
Spring Setting	II	2
Rest Action	I	1
Damaged Disc	III	3
Fasteners loose	𝍸 𝍸 II	12
Ext. Comp. Omitted		
Gasket		
Case	𝍸 𝍸 I	11
Isolated Switch	𝍸	4
Riveting	𝍸 II	7
Faulty Marking		
Shorting Switch		
Forming		
Zero correction		
Insulation	II	2
Dial Marking		
Incorrectly Tested		
Shorting Contacts		
Continuity	I	1
Loose Items		
Solder Fault	II	2
Untested Unit	I	1
Miscellaneous	𝍸 𝍸 I	11

Fig. 2. Tally Chart for CDG 56 Relay

Table 1: Identification of Problem

Fastener Loose Problem	Remedy	Case Problem	Remedy
Thread		**Process**	
Drawing not clear	Use clear drawings	Powder coating not perfect	Use correct techniques
Drilling not proper size	Advise the drilling unit to make proper size	Finishing not perfect	Inform supplier, corrective action to be taken.
Screw bending	Identify the problem and eliminate	**Skill**	
Wrong threading	Threading should be concentric	Scratches	Supplier to be informed and quality of supply to be improved
Process		Poor inspection	Modern approach to be introduced
Plating not proper	Plating Quality to be monitored	Poor handling	Trained workers to be placed
Over size	Use proper size	**Moulding**	
Curing not perfect	Use proper techniques	Powder formation during assembly	Inspect carefully and ensure that there is no casebend; powder formation to be analysed.
Material			
Poor quality raw material	Order the correct quality material Raw material should be checked and stored	Dimensional difference due to material shrinkage	Tool has been modified to accommodate the change in shrinkage.
Skill			
Lack of training	Organise training by trained workers		
Aversion	Improve motivation towards the goal		
Not using proper tool	Use proper tools and techniques		

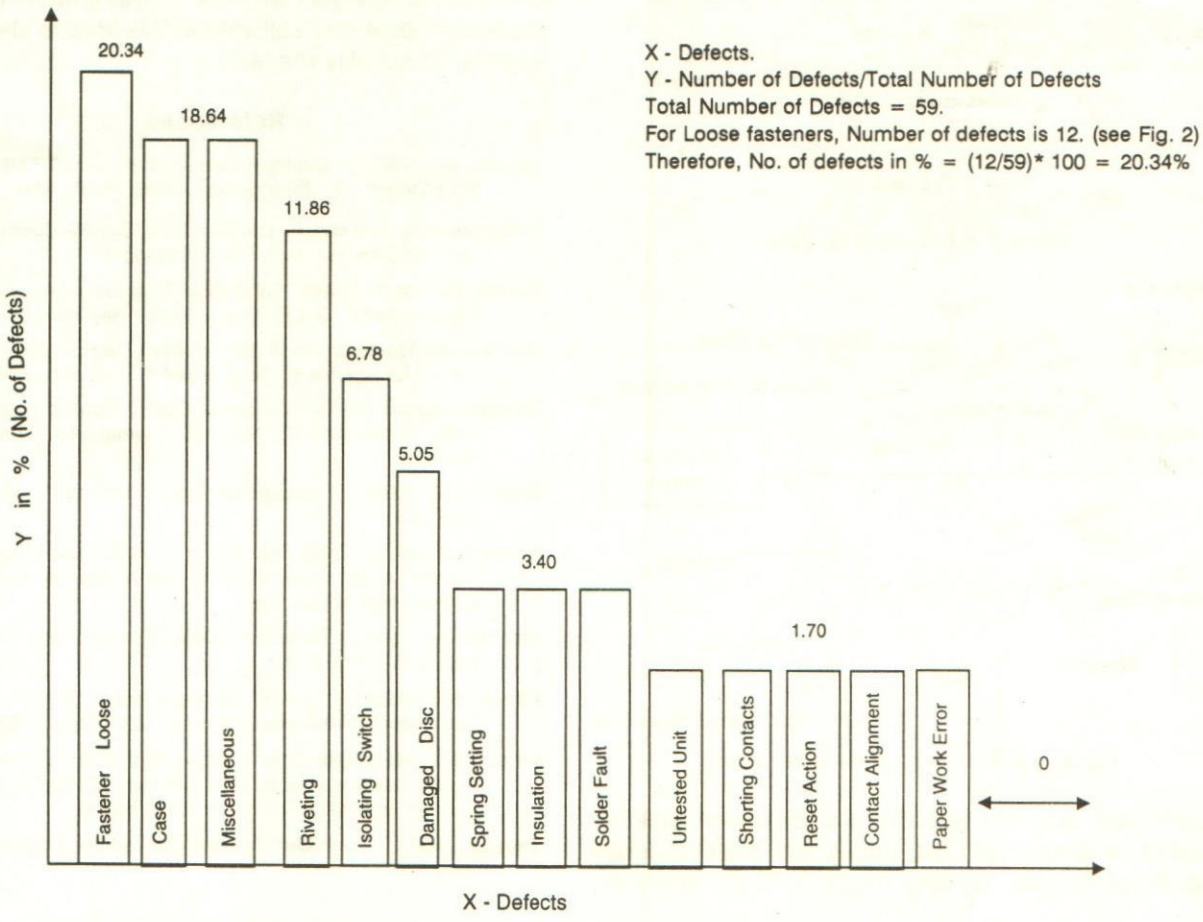

Fig. 3. Pareto Analysis of defects found for CDG 56 Relay type

After getting sufficient data from VAT sheet (i.e., distribution of various defects for CDG56 in August, 1999), an easy way to form the frequency distribution is making a tally chart first, many of the values have frequency of 0, 1 and 2, the values should be grouped (Gerald, 1998), as shown in Fig. 2. Using the data obtained from tally sheet, pareto diagram can be plotted. Pareto principle was epoused by Juran, J.M. (1964) to urge managers to focus on "the critical few rather than trivial many". Pareto chart is useful to rank the data and helps determine which problems to solve in what order. In this work, Pareto chart has been plotted in descending order such as number of defectives in percentage versus defects, which is shown in Fig. 3. From this chart, trivial problems such as fastener loose and case have been identified. Then the factors causing the trivial problems have been identified.

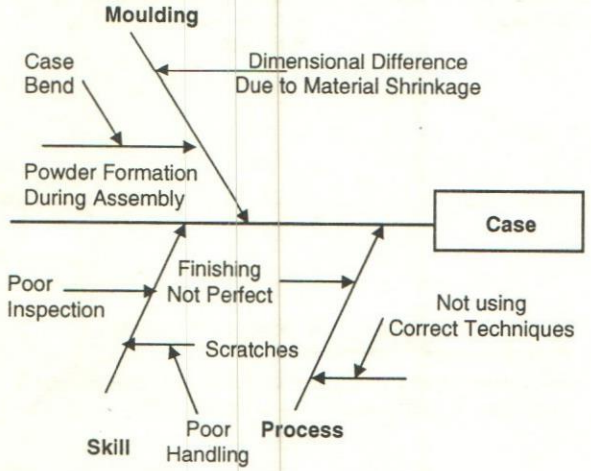

Fig. 4. C & E Diagram for Case

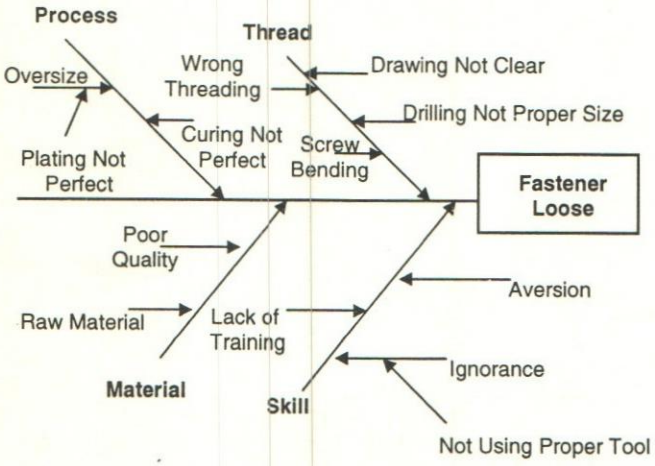

Fig. 5. C & E Diagram for Fastener Loose

Ishikawa diagram is called the Fishbone plot because of its shape; and the Cause and Effect diagram because of its use. By any name, it is an extremely effective graphical method, a basic toolbox given by Ishikawa (1976). For every problem, there are likely to be several major categories of causes. Usually these relate to environment, equipment, materials, methods and men (Zairi. M., 1997). However, these may vary according to the area of improvement. In this study, various causes have been found, the critical few identified and selected for further analysis, which has been shown in cause and effect diagram (Fig. 4, 5).

Conclusions

A Company has to become competitive in order to survive. Achieving and continuously improving required quality level are essential for competitiveness. Trivial problems such as fasteners loose and case have been determined in this case study using Taguchi & Ishikawa techniques, which approximately affected 40 per cent of quality for CDG56 type Relay in August, 1999. An optimal solution has been found for this demerit. It is heartening to note that some of suggestions have already been implemented and the company is in the process of implementing remaining suggestions. Such case studies must also be carried out in other industries keeping cost-benefit analysis in view. Development of mathematical models and software in this area is also needed in order to simplify the task.

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Feature

Cost Leadership – A Strategy For 2000

J.V. Prabhakar Rao & R. Vijaya

Cost cutting is the crucial ingredient for developing cutting edge in the market. This article elaborates on the human resource management practices, financial policies and other production features to be incorporated in an organisation to develop cost leadership.

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Competitive advantage is at the heart of a firm's success in markets. Today it is the competitive edge organisations all over the world are striving for, since they are facing slower growth markets and domestic as well as global competition. Competitive advantage stems fundamentally out of value a firm is able to create for its customers that exceeds the firm's cost of creating it. Value is what customers are willing to pay and superior value can be given to customers by offering lower prices than competitors for equivalent benefits or providing unique benefits that more than offset a higher price.

Competitive advantage stems out of value a firm is able to create for its customers that exceeds the firm's cost of creating it.

Cost Leadership

According to Michael E. Porter competitive advantage can be derived mainly by two generic strategies, Cost Leadership and Differentiation. The strategy of cost leadership is to become the lowest cost producer in the industry through a set of functional policies aimed at this basic objective. Low cost indeed is the most important competitive advantage enjoyed by India's 5 companies which are among Asia's top 20 most competitive ones.

Today Reliance is the lowest cost polyester producer in the world. Its capital cost, labour and selling costs are substantially lower than its global competitors. The cost competitiveness was obtained by its investment in scale, project management capabilities and manufacturing process and the important strength central to this advantage is its ability to compare project implementation time. Reliance has further consolidated its position by deriving locational advantage as all 20 of its plants are central in four location – Patalganga and

Narora in Maharashtra, and Jamnagar Hazira in Gujarat creating cost benefits in terms of savings in transportation costs, Octroi and sales tax. Another edge Reliance possesses is command over process technology, (since its products do not need cutting edge hitech) and the ability to push its production beyond the normal capacity of a plant as its engineers are empowered to develop superior process to increase the utilisation of cost efficient levels. As an example in one of its polymer plants in 1997 a team of engineers succeeded in increasing capacity utilisation by 10 per cent by developing a water treatment process. Ranbaxy achieves cost leadership through multiple cost cutting tools simultaneously. The company employees cut total activity cost by economies of scale, low-cost research helps in raising capacities, redesigning process and benchmarking against International leaders. One of the greatest strengths of Ranbaxy is it is vertically integrated through 5 stages of the value chain, which helps it manage cost and quality across the chain.

Sundaram Fasteners achieves cost leadership through Total Quality management by reducing wastages and thereby costs and by driving down rejection rates. Further reengineering the production process enabled this company to get most out of its large capacity.

Arvind mills is the 3rd largest denim producer in the world whose capacity has been expanded 40 times since 1987 to 1996 and is likely to be the largest producer by 2000. The factors contributing to its cost leadership are the low labour cost of 2.9 per cent of total cost compared to 29 per cent for US-based manufacture, input costs of 5.4 per cent for dyes and chemicals compared to 9.3 per cent in the US and efficiency improvements through process engineering. Bajaj Auto's strategy for cost leadership is to target and tackle inefficiencies in each area so that overall costs are kept in check. It has streamlined its manufacturing operations to achieve cost efficiencies by introducing technology development which identifies new Technologies, Product Development which oversees new launches, product upgradation which attends to product changes; field quality improvement which resolves design related problems; and value engineering which manages inventory costs.

Low cost position gives the firm broader scope of operation, yields above average returns in industry and enables it to defend against the 5 important competitive forces—the intensity of rivalry, bargaining power of suppliers and buyer, threat from substitutes and proves to be an entry barrier.

Tata's Indica, the first indigenously developed car in the country which rolled out on December, 30th 1998 is the outcome of the cheapest car project to be taken up anywhere. The project cost of Telco is Rs. 1,700 crores to make 1,00,000 cars roughly against the normal cost of Rs. 3,500 crores. This 50 per cent cost reduction was possible due to smart planning. It took just 31 months for the first car to roll out from the time the design was frozen as against the standard time of 35-38 months. Much of the credit for the massive cost saving goes to Telco's Engineers who reengineered the equipment and adapted suit the company's needs. At the spanking new K-Block, the facility at Chikli near Pune for manufacturing Indica, parts of the assembly line have been brought from Nissan, Australia for Rs. 90 crores. The Engineers modified the hungars and other critical parts for the plant that were used earlier to produce Nissan's Bluebirds and pulsar models. According to Telco's executives, a similar brand would have costed over Rs. 4000 crores.

Low cost position gives the firm broader scope of operation, yields above average returns in industry and enables it to defend against competitive forces.

Human Resource Management for Cost Efficiency

Cost leadership is possible through a comprehensive approach. All the value addition activities carried out by the firm should be given due consideration for the identification of inefficiencies so that they can be tackled to reduce costs and improve efficiency. Overall cost leadership, as a target can be achieved through proper functional policies designed for the purpose.

The quality and quantity of human resource of an organisation form a major chunk of the total costs of the organisation. As many organisations today are discovering, having too many wrong people and too few right ones, is expensive. Hence it is essential to have the best job—person fit, with the right productivity level for every job and every person. In fact it is the human resource that can help reduce costs in all functional areas, be it marketing, finance or production.

Hiring is an important function of human resources management. Getting right people right the first time is very important as the costs involved in recruiting, induction and training have an impact on costs of hiring. Proper need based and focused hiring reduces costs of wrong hire, training and induction since skill gaps

will be low. Internal source of recruitment is more cost effective provided the organisation has the right people within. Many reputed organisations today are using the practice of recruiting persons as trainees and developing them to fill in the higher posts as this practice is more cost effective than mid-career recruits from the market. According to a Delhi-based consultancy, the recruitment cost of a middle level manager in high demand functional areas like Finance & HR can run as high as Rs. 3 lakhs.

Surplus manpower is another problem which many organisations, especially public sector companies, are facing today. Dowsizing is an important practice for cost reduction. Flat organisations with less managerial layers are more cost effective as the senior managerial compensation has soared by an average of 200 per cent over the past 5 years and is atleast 10 times the salary of a shop floor worker. Apart from being less costly, flat organisations ensure more autonomy to employees with greater span of control and proper communication which can further increase performance efficiency. Elimination should be based on evaluation and ensure removal of non performers and not performers. The worker strength of ICI has dropped from 4,000 in 1995 to 2,800 in 1998 despite the addition of 2 new businesses by redesigning the organisational hierarchy, to make it less top heavy. As a result the ICI's employee costs have come down to 8.5 per cent of its turnover in 1998 from 10.5 per cent in 1995 and this is expected to further be reduced to 7 per cent this year.

Surplus manpower is another problem which many organisations, especially public sector companies, are facing today.

It is important to have a proper match between the needs of the company and the responsibilities of individuals to ensure that there are no gaps in either direction. If there is a mismatch, a reorganisation should follow whereby there is redevelopment and reassignment of people according to the needs of the organisation to improve their productivity. The more a company helps its employees increase their productivity, the lower are its costs on human resources.

Compensation Policy

Compensation adds directly to the overall cost of an organisation. Most organisations have a compensation policy whereby the remuneration is fixed based on the designation, qualifications and experience and very rarely linked to performance. Pay should be according to the employee's contribution to the financial improvement of the organisation, a good example of one such way is profit sharing scheme. Seniority and Tenure of employees contributes more to their pay packets older employees earn more. Schemes like VRS and golden handshake can be employed for cutting down costs. The motive behind such practices is to have energised workforce with lesser cost.

Pay should be according to the employee's contribution to the financial improvement of the organisation.

An example in this respect is Whirlpool of India which after it has merged its acquisitions TVS-Whirlpool and Kelvinator of India saddled 8,500 workers and 14 managers to reduce workforce and flatten the hierarchy. A VRS for 2,500 white collar staff in sales and marketing was designed with 3 months basic salary for every year of service; 1,600 white collar workers and 1,100 blue collar workers have thus left. In a span of 3 years there was a net reduction of 14 per cent in Whirlpool's wage costs apart from meeting the VRS expenditure. There is another interesting fact, that the cost per employee in the organisation is directly proportional to the average employee age. At Faridabad plant the average age is 35 years and cost per employee is Rs. 10,000; in Pondicherry average age is 30 years and cost is just Rs. 6,000 and in Pune Plant Whirlpool has been hiring in the age group 20-25 whereby the cost would be Rs. 4,000 per employee.

Overstaffing and understaffing, both add to the costs of an organisation—the former by bloating salary bills and the latter by requiring costly interventions to compensate for unfinished tasks. Optimum Manpower is the most cost effective. Cost leadership requires a holistic approach to increasing the company's output, to the maximum extent with the minimum monetary inputs in its people-management activities at every stage of the MR value chain.

Financial Management

The finance function is very crucial for an organisation's success. Financial management deals with proper acquisition and use of financial resources. Money costs money and managing capital costs to acquire the required capital at minimum cost contributes to cost leadership. Added is the importance of the best

capital usage patterns for cost effectiveness. One technique to get capital at low cost is by securitisation of future export earnings i.e., low cost capital seekers can convince their lenders that their money will be safe by pledging the revenue sources from their exports which is also against currency risks as the repayments will be from dollar earnings. The Essar group has raised $537 million (Rs. 2,255 crores) through such deals. It has securitised its earnings from exporting hot rolled coils and iron pellets to CMC Traders for a loan of $325 million to help finance its Rs. 6,000 crores hot rolled coils project. The average cost of the 7 year loan is 8 per cent, 3 per cent less than the interest rate on a 7 year foreign exchange loan for a highly rated Indian Company. Domestic lenders are in favour of security of future receivables and are offering capital at lower costs. Ashok Leyland Finance has raised Rs. 1,200 crores since June 1995 at rates between 14.25 and 14.75 per cent, 2 per cent lower than the market, simply by scrutinising its hire purchase receivables through 23 deals with banks, Fis & NBFCs. It is being observed that credit rating of organisations is not a factor limiting them from getting the advantage of low cost of capital. Even BB rated companies can borrow as AAA + rated companies if they can find a bank institution or a AAA + rated company in India or abroad to guarantee their borrowings.

One technique to get capital at low cost is by securitisation of future export earnings.

An example in this context is BPL which has raised Rs. 300 crores in 1997 for its Cellular phone project from the FIs at 14.5 per cent, 2.5 per cent less than the normal cost by convincing the IDBI to guarantee the loan.

Convertible preference shares (CPS) have been used by the TATA finance to raise Rs. 100 crore through a private placement of cumulative CPS. Priced at Rs. 100 each, they will be converted into shares after 3 years. The conversion price would be of a premium of Rs.25 over the market price or average price in the previous 6 months, whichever is lower. The average cost of funds is 11 per cent – 4.5 per cent less than regular issue of cost of debt. CPSs combine the best qualities of debt and equity from the investors' point of view as the payment is in the form of dividend and not interest to be taxed which makes it popular with the FIs and on the other hand, there is an option of converting it into shares after a predetermined period.

The working capital or the money for daily use in an organisation also requires closer attention, for cost reduction. Blocking of working capital should be prevented by preventing piled up inventories, unpaid bills from debtors and larger production and delivery cycles. Certain Companies like Bombay Dyeing are acquiring working capital at cheaper rate by using commercial paper which are short term and are offered at less interest with maturity periods between 91 days and 12 months.

Blocking of working capital should be prevented by preventing piled up inventories, unpaid bills from debtors and larger production and delivery cycles.

Inventory management should be cost effective; slashing of inventories can be achieved by proper relations with the suppliers who can supply inputs as and when the organisation requires rather than maintaining high stock levels which can to same extent be achieved by assuring quick payments after deliveries. The same strategy can be used with downstream partners as well.

Acquiring capital at the minimum cost possible, careful investment in fixed assets without giving scope for unproductive assets, proper management of working capital and efficient inventory management are all tools in the finance which contribute to overall cost leadership.

Purchasing Policy

The purchasing policy is very crucial in determining the costs of the production function and the major cost in many industries is the cost of inputs. Research has shown that almost 8 per cent of the companies in our country have bloated supply chains and efficient procurement can reduce them by atleast 10-20 per cent per annum. Expenses due to poor quality of raw material leading to rejections, high price charged by the vendors and delayed and improper supply, all affect the cost structure. On the nature and cost of supply of raw materials, depends the Make or Buy decision. Chemplast Sanmar, a poly vinyl chloride manufacturer, until recently depended on imports of its major raw material Ethylene dichloride. When the global prices of this input increased thrice per ton raising costs and also making its supply unpredictable, the company has set up its own Ethylene dichloride plant, even though it has to keep it inoperative for 6 months every year.

Inventory Management is another phase where costs pile up. The period for which inventory is maintained is

just a few hours in Japan as against months in India. Improper inventory management and control leads to higher ordering costs, carrying costs, costs due to damage of stocks etc., adding to the overall production to cost. Just in time technique and BC analysis of inventory management have been found to be cost effective.

Bajaj Auto, the Rs. 3,442.66 crores company has divided its 3,000 and odd components of its two wheelers into categories A, B and C. 'A' components are of high value and inventories for these items are never more than that for one shift. 'B' include medium value items and the ordering frequency is once a fortnight and the inventory ceiling, one week. 'C' items are low value ones with an ordering cycle of a month. Bajaj Auto has one of the most efficient procurement systems as it had made mandatory for vendors to conform to its self certification programme under which the suppliers guarantee the quality of their output and feed their supplies directly to the production line saving inventory pileups and quality related rejection.

Production Features

Product design deals with the product's form and function. Form implies the shape and appearance of the product while function is related to the working of the product. A good product design should be functionally efficient and should be produced at the lowest possible cost. It should be acceptable to the customer and satisfy his needs. Hence the design must be well thought and workable as subsequent change in design may become forbiddingly expensive.

The focussed act of matching product-features with customer needs is critical. Hyundai Motor India has designed its 999-CC Santro Tall Boy design to meet the unique requirements of the Indian customer, keeping in mind the bad roads, parking constraints and larger family sizes even though it has a flatter 796-CC Atos in South Korea. Hyundai has chosen to launch a car suitable for Indian conditions making the engine more powerful to support an AC and with the interiors roomier.

Proper plant location and layout are two important factors which enable a company to derive cost advantage. A good plant location is one which can derive the advantage of transport costs and other costs involved in acquiring raw materials or costs involved in transporting products to markets. An example is Zandu pharmaceuticals located at Ankleswarin Gujarat as its raw materials (medicinal herbs) are available in the area and its location is near to ports too as it imports some of its raw materials.

Proper plant location and layout are two important factors which enable a company to derive cost advantage.

A good plant layout involves the allocation of spare and the arrangement of equipment in such a manner that overall operating costs are minimised. Hence layout has an impact on the process costs due to delay in operations, wastage of materials, unnecessary handling of inputs or semi-finished goods etc. Reengineering is the tool being used for changing processes to reduce operating costs. Process reengineering is the fundamental and logical tool for rethinking and redesigning the production process to achieve dramatic improvements in performance measures such as costs; quality and productivity.

Total quality management is the shortest route to cost leadership. The underlying principle of TQM is doing right, right the first time every time. It removes the costs of redundancy, rework and rejection. The view that extra quality works up extra costs is being abandoned and downstream losses arising from the loss of customers that poor quality leads to, is being realised. It is now universally accepted that getting a new customer is three times expensive than retaining the existing one.

Total quality management is the shortest route to cost leadership. It removes the costs of redundancy, rework and rejection.

Marketing

The marketing function of an organisation deals with understanding customer needs, wants and demands, developing product portfolio and managing its communication activities. The marketing costs can be reduced by increasing the sales, by incurring less expenditure and by lowering the existing marketing costs without an adverse effect on sales.

Increasing sales with less expenditure is currently being practiced by what is called as brand extension, whereby instead of introducing new brands which is costly, the existing brands are extended into new products. A good example here is Smithkline Beacham Health care which extended 2 of its beverage brands Horlicks and Boost into biscuits. By 1998 both these brands were contributing Rs. 50 crore to Smithkline

Beachams's revenues. The more a company can use its existing brands, the less will be the cost of growth.

Product mix and market mix are two important factors to be taken care of for reduction of marketing costs. The best strategy regarding the above is to have an optimum product portfolio and market mix by weeding out unprofitable products and markets which if continued add to the overall costs. Marketers are discovering that reducing the number of brands and variants and continuing with the key brands in the right price segment is more viable strategy. Procter and Gamble sold the 3 detergent brands it has inherited from its broken JV with Godrej soaps; Ezee, Trilo and Key to Cussons India in June, 1998 rather than continue to lavish marketing budgets on them despite the returns being low.

The heart of modern marketing is STP – segmenting, targeting and positioning. All these phases must be given due emphasis to reduce unnecessary expenditure. Segmentation variables should be properly identified before market segmentation and the attractiveness of each segment should be evaluated before selecting the target market. The possible positioning concepts for each target segment should be identified and the chosen concept can be developed and communicated to the target customers.

The heart of modern marketing is STP – segmenting, targeting and positioning.

The cost of distribution can range between 5 per cent and 50 per cent of cost of manufacturing. An efficient distribution channel is one which enables the product to reach the customer quickly and at less cost. The costs begin to cascade the moment the product leaves the shopfloor, hence the leaner the distribution network, the more profitable and flexible selling gets. The areas where the sales and distribution costs can be reduced in general are costs of transportation, speed and transportation damage, costs of intermediary margins and low sales team productivity, costs of inventory and credit period.

Proper promotional mix and media selection should be taken care of, for reduction of costs incurred in

An efficient distribution channel is one which enables the product to reach the customer quickly and at less cost.

promotional activities. The means of promotion and the media selected should be appropriate so as to reach the right customer, nothing more, nothing less. Promotion efforts on best sellers and not on brands that are not selling, buying media slots in bulk and using cheaper media alternatives are all ways of cost reduction. For companies with huge number of brands, combined media buying is a cost reduction strategy. Take the case of Bausch and Lamb. In 1995 the company spent 22 per cent of its sale on advertising and today it is only 9 per cent. The reason for the drop is, till 1996 the soft contact lens was promoted through advertisements in the mainstream media and its potential customers constituted only a minor portion of the readers of mainline dailies and magazines it had advertising in. In 1977 the company split its advertising budgets 3 ways: main stream advertising to keep the brand awareness, database marketing and promotion in schools and colleges costing a fraction of the mass media budget and narrowing the communication beam on to the right customers.

Conclusion

Attaining cost leadership is not simple. It requires enterprise-wide commitment and cost consciousness should be created among all the individuals of the organisation. Fundamentally organisations can achieve cost reduction only by the participation of its people and empowering them to manage costs, instead of imposing control mechanisms on them. Cost leadership requires investment in a dedicated team led by a top level manager to ensure efficient cost management. Cost management should stretch all the way into the future. The organisation striving for cost leadership must continuously pare costs rather than effecting cost reductions as one-time improvements. Cost consciousness is a pathway for global cost-competitiveness and is an important requirement for today's organisations to remain successful in the liberalised economy.

□

Feature

Demand & Supply Position of Pulses: A Macro Level Analysis

A. Narayanamoorthy

In countries like India where vegetarian population are substantial, pulses play a major role in increasing the protein content is the diet of people. Considering the importance of pulses, many developmental strategies have been introduced since the third plan to increase their production. However, these strategies could not make any increase over the last 40 years in India. As a result of stagnant production coupled with continuous growth of population, the per capita net availability of pulses has drastically declined over the period. In this study, therefore, while analysing the performance of production of pulses over the years, an attempt is made to study the demand and supply scenario of pulses for the period from 2000 to 2030. The study suggests that since nutritional security is important as much as food security, the government should take concerted efforts to develop short-duration and high yielding varieties in pulses as in the case of paddy and wheat.

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Cultivation of pulse crop is important in terms of both nutritional and agronomic view points. From the stand point of agronomy, cultivation of pulse crops contributes to soil fertility through nitrogen fixing bacteria present in their root system (APO, 1982). From the nutritional point of view, pulses not only have high protein content but are also the cheapest source of protein compared to other foodgrains and vegetables as well as animal protein. In countries like India where vegetarian population is substantial, pulses play a major role in supplementing nutrients in the dietary requirement of the people (Dhindsa & Sharma, 1997).

Cultivation of pulse crops contributes to soil fertility through nitrogen fixing bacteria present in their root system.

Pulse crops have been traditionally cultivated across the states in India. India occupies the first place in both the production and the area under cultivation of pulse crops in the world. Presently (1995), India accounts for about 35 per cent in area under pulses and about 26 per cent in production in the world (Table 1). Despite having the rank of largest producer its productivity is one of the lowest. Unlike other important foodgrain crops, productivity of pulse crops has not increased even after the introduction of green revolution in Indian agriculture. The area under pulses has been hovering around 23.56 million hectares (mha) in 1960-61 to 23.17 mha in 1994-95. As a result, production of pulses has also been fluctuating from 12.70 million tonnes (mt) to 14.12 mt during the same period as there is no significant improvement in productivity. Because of stagnant production and continuous growth of population, the per capita availability of pulses has been falling drastically and has gone down below the level of minimum

Table 1: Area, Production and Productivity of Pulses in Selected Countries: 1995

Country	Area ('000 ha)	Production ('000 tonnes)	Yield (Kg/ha)
Nigeria	2220 (3.16)	1850 (3.30)	833
Canada	1248 (3.73)	2090 (3.73)	1674
Mexico	2151 (3.06)	1428 (2.55)	664
Brazil	5060 (7.20)	2941 (5.25)	581
China	4553 (6.47)	5511 (9.84)	1211
India	24925 (35.45)	14820 (26.47)	595
Pakistan	1524 (2.17)	781 (1.40)	513
Turkey	1887 (2.68)	1824 (3.26)	967
Russian Federation	1727 (2.68)	1435 (2.56)	831
Ukraine	1075 (1.53)	1518 (2.71)	1412
Australia	2045 (2.91)	2381 (4.25)	1164
World Total	70317 (100.00)	55997 (100.00)	796

Notes:

1. Total may not tally as we excluded many countries.
2. Figures in brackets are percentage to total.

Source: FAO (1995).

physiological requirement set by the Indian Council for Medical Research (ICMR) and the World Health Organisation (WHO). Since pulses are the important source of protein for the vegetarian population and also an important item in the diet for the poor people of the country, serious concerns have been expressed by researchers and policy makers in the recent period regarding how to increase the production of pulses to meet the future demand and what would be the position of demand and supply of pulses in the future if the present trend of production continues in India. In this context, an attempt was made to analyse the demand and supply scenario of pulses with the following objectives:

- To analyse the comparative performance of pulse production with other important crops over the period from 1950-51 to 1994-95.
- To analyse the changing scenario of the net per capita availability of pulses and compare with the minimum physiological requirement set by ICMR and WHO.
- To review the demand and supply projections of existing studies.
- To estimate and analyse the demand and supply gap in pulses using the minimum physiological requirement set by ICMR WHO.

Data & Method

Since it is a macro-level study, secondary level data have been used for entire analysis. The data relating to the area, production and productivity of pulses and other important crops as well as net per capita availability of pulses for the period 1950-51 to 1996-97 have been compiled from different publications of Government of India. More specifically, the data for this study have been collected from various issues of Agricultural Statistics at a Glance, Area and Production of Principal Crops in India, Indian Agricultural Statistics, Economic Survey of various years and various Five Year Plan documents. Besides these, the study has also used data from some of the earlier studies especially to understand the demand and supply projections.

To analyse the comparative growth performance of pulses with other important crops, growth rate has been computed using log linear function ($\log Y = a + bT$) for three different set of periods: pre-green revolution (1950-51 to 1965-66), green revolution (1966-67 to 1980-81) and post-green revolution period (1981-82 to 1994-95). The supply projections for pulses have been done using least square method for different sets of periods from 1950-51 to 1994-95. The demand projections have been done for both human (household) as well as total demand (human demand plus other allowances) based on the minimum physiological requirement set by the Indian Council for Medical Research (ICMR) and the World Health organisation (WHO).

Production Performance of Pulses

Before analysing the future demand and supply position of pulses, let us understand the actual production of pulses and how it has been changing over the last four decades and also in different plan periods. Varieties of pulse crops are cultivated in India and the intensity of cultivation of each pulse crop varies with state (Narayanamoorthy, 1998). Among different pulse crops, Red Gram (tur) and Bengal Gram (chana) are the major pulse crops of India and these two crops have been cultivated in almost all the states. These two crops together account for about 43 per cent of the total area under pulse crops. Bengal Gram (chana) alone accounts for nearly one third of the total area under pulses in TE 1992-93 (Table 2). However, in the recent period, while

Table 2: Area and Production of Major Pulse Crops in India

Period	Area (m ha)				Production (mt)			
	Bengal Gram	Red Gram	Others	Total	Bengal Gram	Red Gram	Others	Total
TE 1952-53M	7.22	2.34	9.68	19.24	3.75	1.75	3.17	8.67
	(37.53)	(12.16)	(5.32)	(100.00)	(43.25)	(20.18)	(36.56)	(100.00)
TE 1962-63	9.35	2.44	12.23	24.02	5.80	1.67	7.47	11.99
	(38.93)	(10.16)	(50.92)	(100.00)	(48.37)	(13.93)	(62.30)	(100.00)
TE 1972-73	7.57	2.48	11.82	21.87	4.94	1.83	6.77	10.94
	(34.62)	(11.34)	(54.05)	(100.00)	(45.16)	(16.73)	(61.88)	(100.00)
TE 1982-83	7.28	2.92	12.84	23.04	4.75	2.06	6.81	11.33
	(31.60)	(12.67)	(55.73)	(100.00)	(41.92)	(18.18)	(60.11)	(100.00)
TE 1992-93	6.52	3.58	13.09	23.19	4.63	2.29	6.92	13.03
	(28.12)	(15.44)	(56.45)	(100.00)	(35.53)	(17.57)	(53.11)	(100.00)

Note: Figures in brackets are percentage to total.
Source: GOI (1996).

Table 3: Plan-wise Area and Production of Pulse Crops in India

Plan	Area (mha)	%COPP	Production (mt)	%COPP	Productivity (kg/ha)	%COPP
First Plan (1951-56)	21.09	–	10.04	–	475	–
Second Plan (1956-61)	23.71	12.42	11.75	17.03	495	4.04
Third Plan (1961-66)	23.86	0.63	11.14	-5.19	467	-5.56
Annual Plans (1966-69)	22.01	-7.75	10.29	-7.63	467	0.00
Fourth Plan (1969-74)	22.21	0.91	10.90	-5.92	491	5.14
Fifth Plan (1974-79)	23.32	5.00	11.71	7.43	501	2.04
Annual Plan (1979-80)	22.26	-4.55	8.57	-26.81	385	-23.15
Sixth Plan (1980-85)	23.08	3.68	11.77	37.34	510	32.47
Seventh Plan (1985-90)	23.08	0.00	12.55	6.63	543	6.47
Annual Plan (1990-92)	23.60	2.25	13.14	4.70	555	2.21
Eighth Plan (1992-97)	22.62	-4.15	13.38	1.83	591	6.49

Note: %COPP means percentage change over previous plan.
Source: Computed from GOI (1996) and GOI (1998).

the area under bengal gram has been declining, an increasing trend has been noticed in the area under tur. For example, while the percentage of area under bengal gram to total pulses declined from 38.93 in TE 1962-63 to 28.12 in TE 1992-93, the area under Red Gram (tur) crop increased from 10.16 per cent to 15.44 per cent during the same period. As a result of decline of area under bengal gram coupled with a near stagnancy in productivity, the production of bengal gram is almost stagnant over the last three decades. Despite a marginal improvement in the production of Red Gram(tur) crop, the total production of pulses is almost stagnant mainly because of reduction in production of bengal gram which is a major pulse crop (Fig. 1). Altogether, production of pulses has increased only about 4.35 mt in absolute term between TE 1952-53 and TE 1992-93, indicating an average increase of just 0.109 mt per annum.

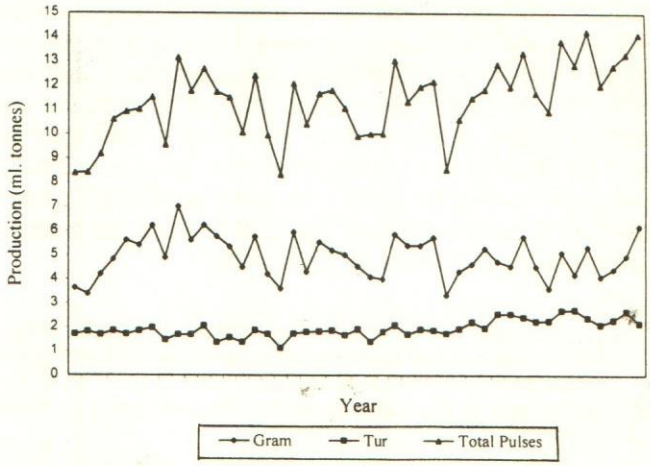

Fig. 1. Production of Bengal Gram (chana), Red Gram (tur) and Total Pulses in India: 1951-52 to 1994-95

The data on plan-wise area, production and productivity of pulse crops also show a dismal picture. The New Agricultural Technology (NAT) introduced in India in the mid-sixties has caused spectacular increase in the production and productivity of most of main food crops especially paddy and wheat[1]. But, contrary to this, NAT has not made any improvement in the production and productivity of pulse crops. It is evident from Table 3 that there is no consistent development in area, production and productivity of pulse crops during different plan periods. Despite the introduction of major programmes such as Intensive Pulses District Programme (initiated during the Fourth Plan) and a centrally sponsored National Pulses Development Programme (which was introduced during the Seventh Plan), the production of pulses has not increased in the subsequent plan periods. A somewhat moderate development had been achieved in both the production and area of pulses during the Second Five Year Plan when compared to the First Year Plan. But, thereafter both the production and area have been fluctuating heavily. In fact, the average production of pulses was lower in the Third, Fourth and Fifth Plan periods when compared to the production of the Second Five Year Plan. Since the Sixth Plan, the production of pulses has been increasing but not significantly. What is clear from the above is that despite the introduction of various programmes on pulses during the plan periods[2], the production is stagnant mainly due to the near stagnancy in the productivity of the main pulse crops.

Comparative Growth Performance

The production of pulses has not increased significantly over the period. However, the reasons for the sluggish growth of production of pulses are not known. It could have been either because of slow growth in productivity or decline in the area under pulse crops. In order to understand the reasons for the sluggish growth performance of different pulse crops and to compare the growth performance with other important crops, we have computed growth rate for area, production, productivity and coverage of irrigation for important pulse crops as well as other crops for three different periods, namely, pre-green revolution period (1950-51 to 1965-66), green revolution period (1966-67 to 1980-81) and post-green revolution period (1981-82 to 1994-95).

1. For example, between 1965-66 to 1994-95, production of rice has increased about 2.06 times (from 30.59 mt to 81.16 mt) and wheat increased about 6.30 times (from 10.40 mt to 65.47 mt) mainly due to impressive growth in the productivity of these two crops.

2. A detailed review on different programmes/strategies introduced to improve the production of pulses during different plan periods is available in Narayanamoorthy (1998).

Table 4: Growth Rate for Area, Production and Yield of Important Crops in India: 1950-51 to 1994-95.

(Area in mha, Production in mt, Yield in kg/ha)

Crops	1950-51 to 1965-66 (Pre-green revolution)	1966-67 to 1980-81 (green revolution)	1981-82 to 1994-95* (Post-green revolution)
Rice			
Area	1.39[a] (33.0)	0.81[a] (38.19)	0.52[a] (41.31)
Production	3.75[a] (29.58)	2.70[a] (43.29)	3.72[a] (66.24)
Yield	2.32[a] (890)	1.88[a] (1130)	3.18[a] (1599)
Coverage of Irrigation(%)	1.14[a] (35.32)	0.64[a] (39.16)	1.09[a] (44.22)
Wheat			
Area	2.35[a] (12.14)	3.43[a] (18.92)	0.64[a] (23.83)
Production	3.85[a] (9.37)	6.58[a] (225.39)	3.63[a] (50.33)
Yield	1.47[a] (768)	3.05[a] (1317)	2.97[a] (2106)
Coverage of Irrigation(%)	0.31 (34.40)	3.34[a] (58.70)	1.61[a] (77.22)
Total Foodgrains			
Area	1.24[a] (111.02)	0.51[a] (123.70)	−0.35[b] (125.76)
Production	2.99[a] (71.37)	2.82[a] (107.18)	2.84[a] (159.68)
Yield	1.74[a] (640)	2.30[a] (864)	3.21[a] (1272)
Coverage of Irrigation(%)	0.84[a] (18.97)	2.26[a] (25.77)	2.06[a] (32.90)
Bengal Gram (chana)			
Area	1.29 (8.88)	−1.05 (7.79)	−1.20 (6.88)
Production	1.77[b] (5.17)	6.74[a] (4.93)	0.33 (4.83)
Yield	0.48 (579)	7.83[a] (632)	1.56[c] (702)
Coverage of Irrigation(%)	0.55 (13.28)	−2,62 (17.22)	3.85[a] (18.52)
Red Gram (tur)			
Area	0.67 (2.42)	0.47 (2.61)	1.46[c] (3.34)
Production	−0.69 (1.72)	1.60[c] (1.78)	0.33 (2.40)
Yield	−1.33 (715)	1.12 (682)	−1.11 (721)
Coverage of Irrigation(%)	−1.33 (0.48)	8.79[a] (0.70)	8.30[a] (4.18)
Total Pulses			
Area	1.49[c] (22.65)	0.39 (22.56)	−0.22 (23.10)
Production	1.63[b] (10.82)	0.25 (10.88)	1.07 (12.68)
Yield	0.13 (477)	−0.13 (482)	1.28 (549)
Coverage of Irrigation(%)	−0.37 (8.82)	−1.48 (8.58)	2.97[a] (9.18)
Total Oilseeds			
Area	2.56[a] (13.16)	1.15 (16.44)	3.43[a] (21.73)
Production	2.97[a] (6.42)	2.14[a] (8.71)	6.17[a] (15.55)
Yield	0.40 (487)	0.99 (528)	2.66[a] (705)
Coverage of Irrigation(%)	11.04[a] (2.77)	7.22[a] (8.35)	4.50 (19.98)

Note: (*) - coverage of irrigation is from 1981-82 to 1992-93.

Figures in brackets are averages of respective variable during that period.

a, b, and c indicate significant at 1, 5 and 10 per cent level respectively.

Source: Computed from GOI (1996).

It is evident from Table 4 that except pulse crops, some kind of consistency is found in the growth rate (area, production and productivity) of all other crops in all the three different periods considered for analysis. The growth rate of production and productivity for paddy and wheat is positive and significant in all the three periods mainly because of the introduction of high yielding cum short-duration varieties. But this has not happened in the case of pulse crops. During the pre-green revolution period, despite an insignificant growth rate in the yield of total pulses and negative growth in the coverage of irrigation, the performance of pulses production was good due to significant growth in the area under total pulses. In the post-green revolution period, in spite of significant increase of coverage of irrigation in the total pulse crops, the area under pulse crops has declined. As a result, there is no significant increase in the production of total pulses during the post-green revolution period compared to the pre-green revolution period. For instance, during the post-green revolution period, the growth rate for coverage of irrigation (in terms of percentage) and the area under total pulses was 2.97 per cent per annum and –0.22 per cent per annum respectively, but the same was –0.37 per cent for the coverage of irrigation and 1.49 per cent per annum for area during the pre-green revolution period. Although the growth rate for the coverage of irrigation is significant for important pulse crops like Red Gram (tur) and Bengal Gram (chana) during the post-green revolution period, it could not significantly increase the area and productivity of these crops. This implies that without the development of high yielding varieties, it is difficult of increase the area under pulses even in irrigated areas. This point can also be further strengthened by comparing the growth rate of oilseeds with pulses. We know that oilseed crops are the most competing crops to pulse crops as both are mostly cultivated under unirrigated condition. Before the green revolution, the productivity of both pulses and oilseeds was almost the same. But after 1980, the position has changed entirely. Due to the introduction of many improved as well as high yielding varieties in oilseeds, the cultivation of oilseed crops under irrigated condition has picked-up. As a result, the area, production and productivity of oilseed crops have increased significantly[3]. It suggests, therefore, that for increasing the production and productivity of pulse crops, it is essential to introduce high yielding varieties as in the case of wheat, paddy and oilseed crops.

3. In the recent years, studies have confirmed that the growth rate of area under oilseed crops is much better than all other crops including wheat and sugarcane because of the efforts taken by the government and co-operative agencies. For more detailed analysis about the performance of different crops across the major states see Sawant (1997).

Without the development of high yielding varieties, it is difficult of increase the area under pulses even in irrigated areas.

Per capita Availability of Pulses

As indicated already, the introduction of new agricultural technology has significant increased production of cereals. As a result of this, the per capita availability has increased from 336.5 grams/day in TE 1952-53 to 446 grams/day in TE 1992-93, an increase of about 32 per cent during this period. Moreover, the per capita availability of cereals has increased consistently without any fluctuations over the period despite reduction in production of some of the coarse cereals. But, in the case of pulses, similar development has not taken place (Table 5). In fact, after the introduction of NAT, the per capita availability of pulses has declined drastically and also consistently. For instance, while the per capita availability of pulses was 63.60 grams/day in TE 1962-63, it declined to 39.00 grams/day in TE 1992-93, showing a reduction of nearly 36 per cent during the period. Perhaps, this is the only important crop where the per capita availability has consistently declined even after the introduction of NAT (Fig. 2). Poor use of yield increasing inputs, non-availability of high yielding varieties, predominant cultivation of pulse crops in the rainfed areas etc., are often cited as the main reasons for the stagnant production and productivity of pulse crops (Pant, 1985; Sadasivan, 1989; Deshpande & Chandrashekar 1982; Chopra, 1982).

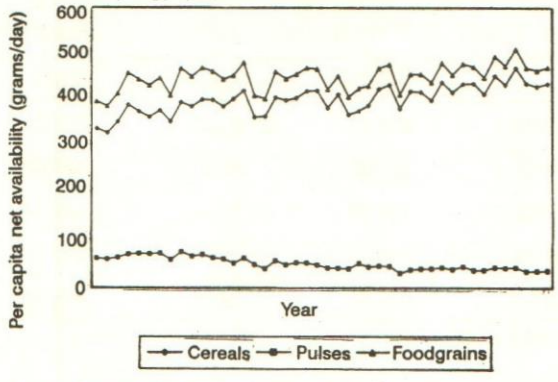

Fig. 2. Percapita Net Availability of Cereals, Pulses and Total Foodgrains in India: 1951-52 to 1994-95

Although existing studies have shown the reasons for the drastic reduction in the per capita availability of pulses in India, they have not analysed whether the net per capita availability of pulses is below/above the minimum physiological requirement. To understand this, we

have compared the per capita availability prevailing in different years in India with the recommendation set by ICMR and WHO. As per the recommendation of ICMR, the per capita minimum physiological requirement should be 43 grams/day and according to the recommendation of Food and Agricultural Organisation (FAO) and World Health Organisation (WHO), the same should be 80 grams/day (Bhushan & Sobti, 1992). Keeping in view the recommendations, we have classified the years based on the per capita availability of pulses from 1950-51 to 1996-97. This is done specifically to understand how many times (years) our per capita availability of pulses is above/below the minimum requirement. The classification of years based on the per capita availability of pulses is presented in Table 6. It is evident that the net per capita availability of pulses in India has never reached the recommendation set by FAO and WHO in the last 50 years period. The highest average per capita availability so far was 71.8 grams/day in 1956-57 and thereafter it has been declining continuously. Even if we take into account the recommendation set by ICMR (which is much less compared to FAO's recommendation), the results are not encouraging. Out of 47 years (between 1950-51 and 1996-97), only in 26 years we could reach the minimum requirement of 43 grams/day set by ICMR and in the remaining 21 years average per capita availability was below the recommended level. Although net per capita availability of pulses was 43 grams/day the first time in 1967-68, most of the years where the availability of pulses was below the level of 43 grams/day, were from later part of the green revolution (GOI, 1998). The implication is that unlike other foodgrain crops, even green revolution could not increase the per capita availability of pulses.

Table 5: Per capita Net Availability of Cereals and Pulses in India

(grams/day)

Period	Cereals	Pulses	Total
TE 1952-53	336.50	60.83	397.33
TE 1962-63	394.20	63.60	457.80
TE 1972-73	405.73	46.43	452.17
TE 1982-83	410.23	38.73	448.97
TE 1992-93	446.00	39.00	485.00

Source: GOI (1998).

Existing Studies

Many studies have projected the demand and supply scenario for pulses for different periods using different methodologies. However, projections are available only for short-term period. That is, some of the studies have projected demand and supply scenario up to 2000-1, while some others have estimated up to 2006-7. As the projected results of the existing studies would be useful to compare with our own projection in the later part of the study, let up review the available studies before analysing our own results.

Table 6: Classification of Years Based on the Per capita Availability of Pulses in India

Below 43 grams/day	43-50 grams/ day	50.1-60 grams/ day	60.1-70 grams/ day	70.1-80 grams/ day	Above 80 grams/ day
1967, 1973, 1974, 1975, 1980, 1981, 1982, 1983, 1984, 1985, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997.	1966, 1969, 1972, 1977, 1978, 1979, 1986.	1952, 1958, 1963, 1964, 1968, 1970, 1971, 1976.	1951, 1953, 1954, 1960, 1961, 1962, 1965.	1955, 1956, 1957, 1959.	Nil

Note: 1951 corresponds to 1950-51 and so on for subsequent years.

Source: GOI (1998).

Bhushan and Sobti (1992) have projected the demand and supply for pulses for the period 1992-93 to 2000-1. The demand projection has been done by two ways—using economic demand model and normatic demand model (Table 7). The economic model was computed based on the per capita net availability of pulses in TE 1990-91, expenditure elasticity and growth of private consumption expenditure. Similarly, for estimating the demand for pulses based on the normatic model, the authors have considered physiological need at the rate of 43 grams/day/person plus 12.5 per cent retail level and production level wastage. According to the normatic demand model, the net demand would be 16.04 mt, in 2000-1 for which the production requirement is estimated to 19.77 mt, but the projected supply of pulses comes to only 16.00 mt indicating a huge (3.47 mt) gap between demand and supply for pulses. Similarly, the projected figures computed based on the economic model have also shown a wide gap between supply and demand for pulses. Importantly, the projections have shown that the gap between demand and supply would go up further because of the fast increase of demand and almost stagnant level of production.

Projections show that the gap between demand and supply would go up further because of the fast increase of demand and almost stagnant level of production.

Table 7: Demand and Supply Projections for Pulses for 2001 AD

(million tonnes)

Year	Economic Demand Model[A]		Normatic Demand Model[B]		Projected SupplyC
	Net demand Require-ment	Gross Produc-tion	Net demand Require-ment	Gross Produc-tion	
1992-93	14.75	16.22	13.79	16.99	13.90
1993-94	15.56	17.12	14.06	17.33	14.20
1994-95	16.42	18.00	14.32	17.66	14.50
1995-96	17.34	19.07	14.60	17.99	14.80
1996-97	18.29	20.12	14.87	18.33	15.10
1997-98	19.31	21.24	15.16	18.68	15.40
1998-99	20.40	19.31	22.44	19.03	15.70
1999-2000	21.51	23.66	15.74	19.40	16.00
2000-01	22.71	24.98	16.04	19.77	16.30

Notes:

A: Economic model is based on the per capita net availability for TE 1990-91, expenditure elasticity and growth of private consumption expenditure.

B: Normatic demand model is based on physiological need @ 43 grams/day and 12.5 per cent retail level and production level wastage etc.

C: Supply Projection: production base level taken as TE 1991-92.

Source: Bhushan, Brij & Renu Sobti (1992).

Another recent study (Kumar & Mathur, 1996) has projected the domestic demand for different foodgrains including pulses in India up to 2006-7. The projections have been done separately for household demand (only human demand) and domestic demand (including allowances for seed, feed and wastage). The results of demand projections are presented in Table 8. It is evident that while the projected supply of all other foodgrains is above the projected demand, supply projection of pulses is much less than projected demand both at the end of Ninth and Tenth Five Year Plans. As indicated earlier, because of the different methods used for projecting demand and supply by different authors, there are wide differences noticed among different studies (see, Table 9). Although there are differences in projections, all studies considered for comparison here have shown that future demand of pulses would be much higher than projected supply. Further, the studies have also cautioned that the gap between demand and supply would be increasing in the future if appropriate action is not taken immediately to improve production of pulses.

It is understood from the projection results of existing studies that there is going to be a wide gap between demand and supply for pulses in 2006. However, the supply projections given by some of the studies appear to be unrealistic and also on the higher side while comparing with the present growth of actual production of pulses. According to the study of Kumar and Mathur (1996), the projected supply of pulses would be 18.2 mt

Table 8: Domestic Demand for Foodgrains in India

(million tonnes)

	1991-92 (Base year)	1996-97	2000-01	2001-02	2006-07
Household Demand					
Rice	67.1	75.0	81.5	83.0	91.3
Wheat	50.8	57.1	62.5	63.7	70.9
Coarse Cereals	20.3	21.6	22.7	22.9	24.2
Total Cereals	138.2	153.7	166.7	169.6	186.4
Pulses	11.7	13.9	15.6	16.1	18.8
Foodgrains	149.9	167.6	182.3	185.7	205.2
Domestic Demand					
Rice	72.6	81.2	88.2	89.8	98.8
Wheat	57.8	65.0	71.1	72.5	80.7
Coarse Cereals	28.9	30.7	32.3	32.6	34.4
Total Cereals	158.0	175.7	191.6	194.9	213.1
Pulses	13.4	15.9	17.8	18.4	21.5
Foodgrains	171.3	191.6	209.4	213.3	234.5

Note: Domestic demand is equal to household (human) demand, pulse allowances for seed, feed and wastage, which is taken as 7.6 per cent of gross Rice production, 12.1 per cent of Wheat, 29.7 per cent of Coarse Cereals, 12.5 per cent of Total Cereals, 12.5 per cent of Pulses and 12.5 per cent of Foodgrains. Thus the grossing factor used is 1.082 for Rice, 1.138 for Wheat, 1.422 for Coarse Cereals and 1.143 for Total Cereals, Pulses and Total Foodgrains to account for non-household demand.

Source: Kumar, Praduman and V.C. Mathur (1996).

Table 9: Supply Projections of Pulses by Different Studies

(million tonnes)

Studies	Year 2001-02	Year 2006-07
Bhushan and Sobti (1992)	16.30*	–
Kumar and Mathur (1996)		
Total Pulses	18.2	21.0
Bengal Gram (chana)	7.1	8.2
Red Gram (tur)	3.3	3.8
Deepak Shah and Mitra (1997)		
Scenario I	14.50	15.50
Scenario II	15.10	16.20
Scenario III	14.60	15.80
Scenario IV	13.80	14.90

Note: * - for the year 2000-1.

Source: Bhushan and Sobti (1992); Kumar and Mathur (1996): Shah

Table 10: Supply Projections for Pulses in India: 2005-2030

Trend Equation		Projected Supply (mt) in the year				
		2005	2010	2015	2020	2030
(1) 1950-51 to 1994-95:						
Scenario I $Y = 9.901^a + 0.065^a$	(0.32)	13.49	14.14	14.46	14.75	15.44
Scenario II $Y = 10.07^a + 0.056^a$	(0.43)	13.15	13.17	13.99	14.27	14.83
(2) 1960-61 to 1994-95:						
Scenario I $Y = 9.729^a + 0.069^a$	(0.25)	12.87	13.57	13.92	14.27	14.97
Scenario II $Y = 10.07^a + 0.056^a$	(0.33)	12.59	13.15	13.43	13.71	14.27
(3) 1970-71 to 1994-95:						
Scenario I $Y = 7.908^a + 0.122^a$	(0.39)	12.18	13.40	14.01	14.62	15.84
Scenario II $Y = 8.26^a + 0.107^a$	(0.61)	12.01	13.08	13.61	14.15	15.22
(4) 1980-81 to 1994-95:						
Scenario I $Y = 6.497^a + 0.159^a$	(0.40)	10.47	12.06	12.86	13.65	15.24
Scenario II $Y = 5.27^a + 0.184^a$	(0.71)	9.87	11.71	12.63	13.55	15.39
(5) 1990-91 to 1994-95:						
Scenario I $Y = 9.004^{ns} + 0.100^{ns}$	(0.03)	10.50	11.50	12.00	12.50	13.50
Scenario II $Y = 16.69^a - 0.082^{ns}$	(0.12)	15.46	14.64	14.23	13.82	13.00
(6) 1964-65 to 1994-95:						
Scenario I $Y = 8.77^a + 0.098^a$	(0.38)	12.89	13.87	14.36	14.85	15.83
Scenario II $Y = 9.09^a + 0.085^a$	(0.60)	12.66	13.51	13.94	14.36	15.21
(7) 1975-76 to 1994-95:						
Scenario I $Y = 7.58^a + 0.131^a$	(0.34)	11.64	12.95	13.61	15.70	15.57
Scenario II $Y = 7.31^a + 0.133^a$	(0.65)	11.43	12.76	13.43	14.09	15.42
(8) 1985-86 to 1994-95:						
Scenario I $Y = 6.86^a + 0.149^{ns}$	(0.21)	9.99	11.48	12.22	12.97	14.46
Scenario II $Y = 8.56^a + 0.104^b$	(0.43)	10.74	11.78	12.30	12.82	13.86

Notes: a and b are significant at 1 and 5 per cent level respectively; ns - not significant.
Figures in brackets are R^2.
Scenario I is computed based on actual year-wise data and Scenario II is computed based on Triennium average.
Source: Computed using GOI (1996).

in the year 2001-2 and 21 mt in 2006-7. That is, to achieve the target of 21 mt in 2006-7 the production should be increased to the level of 0.63 mt per annum between 1994-95 and 2006-7. But, considering the production performance of pulses of the last decade, it would be very difficult to reach the target set by Kumar and Mathur (1996). For instance, the actual production of pulses increased from 11.33 mt in TE 1982-83 to 13.3 mt in TE 1992-93, showing an absolute increase of 1.7 mt during this period. That is, on an average, the production of pulses increased just by 0.154 mt per annum between TE 1982-83 and TE 1992-93. Therefore, considering the present growth of pulses production, it is very difficult to attain the production target set by the study of Kumar and Mathur (1996). Similarly, the supply projection of Bhushan and Sobti (1992) was also already proved as unrealistic when compared to the actual production of pulses. For instance, according to their projection, the supply of pulses should have been 13.90 mt in 1992-93, 14.20 mt in 1993-94 and 14.50 mt in 1994-95. But, contrary to this, the actual production of pulses in these years was 12.82 mt, 13.30 mt and 14.12 mt respectively. That is, the actual production is less than the projected supply in all the three years.

However, on the other hand, a most recent study by Shah and Mitra (1997) has shown an entirely different supply projections for pulses from the earlier mentioned studies. This study has projected supply for pulses for different alternative scenarios for the year 2001 to 2006 using actual production data from 1979-1993. According to this study, the supply projections figures vary from 13.80 mt to 15.10 mt in 2001 and 15.50 to 16.20 mt is 2006 (see; Table 9). Although the projection of this

study appeared to be more realistic than other studies reviewed here, no attempt was made to estimate the gap between demand and supply for pulses.

Supply Projections for Pulses (2005-30)

As the projected supply varies considerably across the available studies and also some of the projected results are more unrealistic when compared to ground realities, we have projected supply for pulses for the period from 2000 to 2030 using different sets of years. In order to project the supply, we have used the actual production data of pulses relating to the period from 1950-51 to 1994-95. Projections vary depending upon the selection of period and methodology considered for analysis. Furthermore, in countries like India, which has vast geographical area and diversified agro-climatic conditions, a small change in production in some parts of the country can completely disturb the projections and can make results more unrealistic. Keeping these points in view, we have projected supply for pulses by choosing eight different sets of periods specifically to understand how the projected supply varies among different set of periods. The results of supply projections for pulses for the period 2000 to 2030 are presented in Table 10. As expected, the projected supply varies significantly among different periods. The projected figures relating to the periods 1980-81 to 1994-95, 1985-86 to 1994-95 and 1990-91 to 1994-95 are more unrealistic as the actual production of pulses is already more than the projected supply. This could be because of the wide fluctuations in the year to year actual production of pulses. Except the above mentioned three periods, the projected supply is almost the same in the remaining five periods. Interestingly, the projected supply relating to the periods 1950-51 to 1994-95 and 1964-65 to 1994-95 is almost the same. This shows the obvious fact that production of pulses is almost the same before and after the introduction of green revolution in Indian agriculture. As most of the supply projection appears to be realistic, we have chosen a relatively higher side projection figures relating to the period 1964-65 to 1994-95 for estimating the demand and supply gap for the periods from 2000 to 2030.

Production of pulses is almost the same before and after the introduction of green revolution in Indian agriculture.

Demand & Supply Gap for Pulses (2000 to 2030)

As in the case of supply projection, many studies have projected demand for pulses as well. The projections are available separately for both total demand (including allowances for seed, feed and wastage) as well as for human demand. It is understood from existing studies that the net demand requirement of pulses computed based on the economic model (using expenditure elasticity, growth of private consumption expenditure and per capita net availability) was higher than the projections computed based on the normatic demand model. It is true that since the normatic demand model considers only the minimum physiological requirement, the estimated figures are always on the lower side compared to the demand arrived at using the economic model. Considering the difficulties in employing the economic model, we have projected demand for pulses only by taking the physiological minimum requirement of pulses set by ICMR and WHO which is 43 grams/day/person and 80 grams/day/person respectively. Since the projected population is essential for estimating the physiological minimum requirement, we have compiled population data from the World Bank working paper No. 115 (My T. Vu et al., 1988) as the estimated population is not available beyond 2016 from the Census of India (GOI, 1996).

The net demand requirement of pulses computed based on the economic model was higher than the projections computed based on the normatic demand model.

Table 11 presents the projected demand for pulses as well as the demand and supply gap for the period from 2000 to 2030. It is evident that there is going to be a wide demand and supply gap in the future as indicated by earlier studies. Since the demand figures projected using the minimum physiological requirement of WHO is very high and also unrealistic, here we intend to analyse only the demand and supply gap estimated based on the recommendation of ICMR. As per the recommendation of ICMR, in the year 2010, the household demand (human demand) alone comes to about 17.86 mt for which total production should be about 20.41. Since the projected supply comes to only about 13.87 mt for this year, the gap between the household demand and supply would be about 3.99 mt in the year 2010. If we take into account the total demand (including other allowances) of the same period, the gap would go up further to the level of 6.54 mt. The projected figures also show that the supply and demand gap would further be widened in the future due to the continuous growth of population. Further, if the projected supply of pulses turns out to be correct, the supply can satisfy only about 69 per cent of the total

Table 11: Demand and Supply Gap for Pulses in India: 2000-2030

Year	Project Population ('000)*	Demand Projection I (43 grams/day/person)		Demand Projection II (80 grams/day/person)		Supply** Projection	Demand and Supply Gap [A]	
		Human Demand	Total Demand	Human Demand	Total Demand		Human Demand	Total Demand
2000	1001859	15.72	17.97	29.25	33.43	12.40	3.32	5.57
2005	1073725	16.85	19.26	31.35	35.83	12.89	3.96	6.37
2010	1137980	17.86	20.41	33.22	37.97	13.87	3.99	6.54
2015	1200467	18.84	21.53	35.05	40.06	14.36	4.48	7.17
2020	1262912	19.82	22.65	36.88	42.15	14.85	4.97	7.80
2025	1323317	20.77	23.74	38.64	44.17	15.34	5.43	8.40
2030	1379109	21.65	24.75	40.27	46.03	15.83	5.82	8.92

Notes:

1. Demand projection I is based on the ICMR's minimum physiological requirement.
2. Demand projection II is based on the FAO and WHO's minimum requirement.
3. Supply projection is based on data from 1964-65 to 1994-95.
4. Total demand is human demand plus allowances for seed, feed and wastage which is considered as 12.5 per cent for pulses.
5. A - Demand and supply gap is estimated based on demand projection I.
6. Supply and demand projections for pulses are in million tonnes.

Source: *-from My T. Vu, et al., (1988); **-estimated from GOI (1996).

demand in 2000 and about 63 per cent in 2030. In order to achieve the total demand of 24.75 mt projected for the period 2030, average production of pulses should be about 0.41 mt per annum between 2000 and 2030 in case the projected supply of 12.40 mt turns out to be correct in the year 2000. Considering the average actual production of 0.17 mt achieved during the last decade (between TE 1982-83 and TE 1992-93), reaching the target of 0.41 mt/year would be herculean task.

Due to continuous development of irrigation, farmers tend to shift the area from pulses to better remunerative crops in the recent period across the states in the country. Thus, the possibilities for bringing more area under the cultivation of pulse crops are very less. Moreover, as in the past, since the acreage response with respect to price of pulses has been found to be very low by recent studies (Dhindsa & Sharma, 1997), the continuous increase of minimum support price for pulses could not bring any impressive change in the production of pulses. Therefore, as nutritional security is as important as food security, both Central and State governments should take concerted efforts to bring about technological improvements particularly on short-duration and high yielding varieties development, by allocating more funds for research and developmental activities on pulses.

As nutritional security is as important as food security, governments should take concerted efforts to bring about technological improvements particularly on development of short-duration and high yielding varieties.

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□

MANAGEMENT THOUGHTS : BY PRAMOD BATRA

If I had 8 hours to chop a tree I would spend 6 hours sharpening my axe

"The will to win is worthless if you do not have the will to prepare." Sky scrapers take only a year to build but many years to plan. And, patience in planning, impatience in execution has worked wonders.

□ Think Inc., Batra

Feature

Sugarcane Production – Estimation of Economic Efficiency

K. Ramasamy & C. Kailasam

Measurement of the two components of economic efficiency viz., technical efficiency and allocative efficiency are useful in many ways. Comparison across similar economic units to evaluate relative efficiency and to identify the causes for variation in efficiency has been dealt by many researchers. This paper discusses the estimation of technical efficiency of sugarcane production by Corrected Ordinary Least Square (COLS) method and Maximum Likelihood Estimation (MLE) Method.

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Sugarcane is a long duration seasonal crop cultivated for its cash income. Therefore, farmers are careful to ensure optimal use of resources, to gain maximum possible return. But, they have to meet with several constraints that limit their performance. In this context, the concept of economic efficiency is important and it has two components: technical efficiency and allocative efficiency, both measurable from production function. In the classical non-stochastic theory of a firm, production function is defined as "...a schedule showing the maximum amount of output that can be produced from a specified set of inputs, given the existing technology" (Ferguson, 1966). Several statistical models that are consistent with this definition of a production function, have been discussed in literature (Aigner & Chu, 1968; Timmer, 1971; Schmidt, 1986; Kumbhakar, 1994). In 1957, Farrell introducted a technique with which the efficiency of a production activity could be measured and decomposed into technical and allocative components. The standard of efficiency used by Farrell was the frontier unit isoquant – a concept which evolved into the production and cost frontiers of today. Farrell associated deviations from the frontier isoquant with technical inefficiency and deviations from the cost minimising input ratios with allocative inefficiency. Of the two, technical efficiency depends on several factors that are beyond the control of farmers and its measurement will be useful to know the gap in adoption of production technology. Moreover sugarcane is cultivated for two different purposes: to be delivered to sugar mills for preparing sugar and to make jaggery. Even though milling helps better recovery of sweetening agent than jaggery, the latter has a significant share in the consumer's budget and consequently there is a ready market for jaggery also. Therefore focus of this study is to measure technical efficiency of sugarcane used for jaggery.

Methodology

Coimbatore district was purposively chosen as the

study area because it has largest area under sugarcane among the districts in Tamil Nadu. Sugarcane was selected for this study because it is a cash crop raised in irrigated lands. Farmers cultivate sugarcane mainly for the cash income and this goal motivates them to adopt modern technology, the extent of technology adoption is expected to be high. Secondly, in sugarcane, ratooning is a common practice and technology differs to some extent between main (planted crop) and the ratoon crops. This allows a comparative study of technology for two different situations of the same crop.

Farmers cultivate sugarcane mainly for the cash income and this goal motivates them to adopt modern technology.

This study is based on primary data for the fasli (crop) year 1997-98 covering both planted and ratoon crops of the year. The crop year refers to 12 months from July 1, to June 30 next. The primary data was collected from 80 sugarcane growers, for both planted and ratoon crops raised in the farm. In this study technical efficiency of sugarcane was measured by using the Statistical Frontier Production Function.

Following Greene, a statistical production frontier can be expressed as:

$$Y_i = \alpha_0 + \sum_{j=1}^{k} \beta_j \; X_{ij} - \in_i \qquad (1)$$

Where α_0 is the intercept term, $\in_i$ is assumed to be identically and independently distributed with non-negative mean and finite variance, α_0, β_j are parameters to be estimated, Y_i is production of sugarcane, X_{ij} are inputs used and measured in their log values. Therefore, it was a Cobb-Douglas form, transformed to a linear estimable form.

The main issue in estimating statistical frontiers is whether the efficiency differences are assumed to be induced by an explicit distributional form or not. Greene (1980), has shown that, as long as $\in_i$ meets the assumptions stated above, regardless of its distributional form, the frontier can be estimated by applying a very simple correction to the intercept term obtained from the ordinary least squares (OLS) estimation. However, if an explicit assumption for the distribution of the disturbance is introduced, the frontier must be estimated using maximum-likelihood techniques.

If the statistical production frontier is estimated assuming no explicit form for $\in_i$ distribution, then OLS provides the best linear unbiased estimate of the slope parameters β_j $(j = 1, ..., k)$, and the conventionally computed standard errors for these estimates are appropriate. If the assumption does not hold, however, the OLS intercept is biased downwards and must be corrected. The method is therefore called corrected ordinary least squares (COLS). An estimate of the intercept term, as proposed by Greene, can be obtained by shifting the constant term upward by an amount equal to the largest positive residual ($\in_{max}$). When this correction is made, all residuals are non-negative and at least one is zero, implying that no farm can exceed 100 per cent efficiency.

$$Y_i = (\alpha_0 + \in_{max}) + \sum_{j=1}^{k} \beta_j \; X_{ij} - (\in_i + \in_{max}) \qquad (2)$$

As can be seen from equation (2), the production frontier estimated with COLS is a naturally scaled version of the OLS or average production function. With the help of estimated production functions, technical efficiency was measured by the ratio of anti-log values of estimated Y to that of actual Y. For convenience, it was expressed as a percentage and called technical efficiency index (TE).

$$\text{(i.e.,)} \qquad TE = \frac{Y_i}{\hat{Y}_i} \times 100$$

where Y_i and $\hat{Y}_i$ are estimated and actual values of Y in t / ha. This index enabled ranking and classification of farms into technical efficiency classes.

Findings

Statistical production frontier estimated by corrected ordinary least square method had the advantage of making available the standard errors of the partial elasticity coefficients, the coefficient of multiple determination and the F statistics, that enable the evaluation of the validity of the estimated equation for drawing inference. Two functions were estimated, one for planted crop and another for ratoon crop cultivated, harvested and made into jaggery during the year of study. They were estimated by COLS method.

As could be seen in the table, the values of R^2 in the two equations were small (0.51 and 0.61) showing small explanatory power, however, they were statistically significant at one per cent level. The coefficients of labour and capital were also statistically significant

at one per cent level and had the positive sign as expected *a priori*.

Therefore, the estimated equations were valid to draw inferences. The partial regression coefficients of labour and capital were their respective production elasticities as the function form was log – log (i.e., Cobb-Douglas) and they were statistically significant. The sum of these production elasticities was the functional coefficients that measured returns to scale. The values of the functional coefficients were close to unity for the planted crop and less than unity in the ratoon crop and were statistically significant, revealing increasing and decreasing returns to scale in production of planted and ratoon crops respectively.

Table 1: Statistical Production Frontier (STATC) for sugarcane – Planted and Ratoon Crops estimated by COLS method

Variables		Planted (n = 80)	Ratoon (n = 80)
Production intercept	β_0	3.9712	4.1763
Labour input	β_1	0.2215** (6.24)	0.1800** (8.17)
Capital	β_2	0.8107** (3.56)	0.5086** (4.89)
Function coefficient	γ	1.0322	0.6886
R^2		0.51**	0.61**
R^{-2}		0.49**	0.59**
F		21.83**	33.51**

Note: Figures within () are t statistics
** – Significant at 1% level

Technical Efficiency

Technical efficiency in sugarcane production was measured by *TE*, as defined and the farms were grouped into six *TE* classes as shown in Table 2.

Table 2: Classification of Sugarcane Farms by their Technical Efficiency level (TE)

TE Classes	Planted		Ratoon	
	No	%	No	%
100	4	5.0	3	3.8
90-100	10	12.5	6	7.5
80-90	20	25.0	14	17.5
70-80	28	35.0	32	40.0
<70	18	22.5	25	31.2
Total	80	100.0	80	100.0

Note: No. – No. of farms in the TE class
% – Percentage to column total

In the table, most number of farms were seen in the class of 70-80 of *TE* for both crops of sugarcane. There were lesser number of farms in the first (top) two classes for ratoon crops than for planted crops. Thus, there are clearly lower performance in ratoon crop as compared to planted crop. Use of COLS was necessary because of no assumption about the distribution of inefficiency term. This was a limitation of this model.

Maximum Likelihood Method

Another way of estimating the statistical production frontier was to use maximum likelihood method, with the assumption of a gamma distribution of the inefficiency term, (i.e.,) deviation from the frontier. The estimated functions are presented in Table 3.

Table 3: Statistical Production Frontier (STATM) for Sugarcane – Estimated by Maximum Likelihood Method

Variables		Planted (n = 80)	Ratoon (n = 80)
Production intercept	β_0	3.6897	3.2467
Labour input	β_1	0.2733** (3.98)	0.2864** (3.76)
Capital	β_2	0.9681** (4.63)	0.8942** (4.07)
Function coefficient	γ	1.2414**	1.1806**
μ		2.31	3.17
P		3.96	5.03
Log-likelihood value		298.98	299.56

Note: Figures within () are t statistics
** – Significant at 1% level

Table 4: Classification of Sugarcane Farms by their Technical Efficiency level (TE) (STATM)

TE Classes	Planted		Ratoon	
	No	%	No	%
100	10	12.5	4	5.0
90-100	14	17.5	15	18.7
80-90	28	35.0	26	32.5
70-80	13	16.2	12	15.0
<70	15	18.8	23	28.8
Total	80	100.0	80	100.0

Note: No. of farms in the TE class
% – Percentage to column total

The coefficients of both labour and capital were statistically significant at one per cent level and had positive sign. The functional coefficient had values

larger than unity and the values were found to significantly differ from unity. Thus, there was increasing returns to scale in both planted and ratoon crop. The values of μ varied from 2.31 to 3.17 and the values of *P* varied from 3.96 to 5.03. When the value of μ was restricted to be greater than zero and that of *P* to be greater than two, the maximum likelihood function would be well behaved as shown by Greene (1980). Therefore, the estimated functions were expected to be well behaved (vide values of μ and *P*) and were useful to draw inferences and to calculate *TE*. The calculated values of TE were used to classify the farms as shown in Table 4.

From the table, it was seen that the peak of the distribution of farms was in the class interval of 80-90 for *TE* for both planted and ratoon crops. There were only few farms (12.5 per cent in planted crops and 5.0 per cent in ratoon crop) with 100 per cent technical efficiency. However, the number of farms with TE of value less than 70 per cent was also small for planted crop but it was relatively large for ratoon crop. It was not difficult to see that farms were less technically efficient in ratoon crops as compared to planted crop (Shrivastava et al, 1992; Sundara, 1998). Close to normal distribution of farms by their level of *TE* was discernible.

Farms were less technically efficient in ratoon crops as compared to planted crop.

Conclusion

The index TE gives an objective measure of technical efficiency in crop production, enabling ranking and classification of farms into efficiency classes. Once this is done, it is possible to make comparative study of efficient ($TE > 90$) and less efficient ($TE \leq 70$) farms and relate their structural and operational constraints to the farmers' success in adopting technology. It must be also possible to study the association between technical efficiency and allocative efficiency of farms. This model applied to sugarcane production is simple enough to be applied to other crops also. The maximum likelihood method of estimation is more appropriate on account of explicit assumption about the distribution of random error term than the COLS method that simply ignores it. However, the estimated technical efficiency index differed only in a small way for the two methods of estimation. COLS method is preferred for its simplicity. Whatever be the method of estimation, the statistical frontier model has one limitation in that all deviations from the frontier is attributed to technical inefficiency and ignores facts that are beyond farmer ability such as adverse weather and imperfect market that cause random variation in crop production.

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News & Notes

Failed Government Policies

An estimated $ 10-28 billion is frittered away due to lost productivity, illness and death

Health does not seem to be the priority area for the government. The World Health Report 2000 claimed that while only 1 per cent of India's gross domestic produce (GDP) is being used in the field of health care, three times this amount is being used for defence. There are plans to increase healthcare spending to five per cent but this would still be less than what a developed country like the US is spending on health. Though money is not the only criterion for making a country healthy, misplaced priorities are not likely to help.

Eradication of tuberculosis (TB) from India is a lost cause. Even after 40 years of existence of the National Tuberculosis Programme, this disease remains one of the nation's top killer disease claiming nearly 4.2 lakh lives every year. Nearly three lakh children drop out of school and one lakh women are abandoned every year due to TB. The link between TB and AIDS has made the disease even more deadly. According to the Bihar government, the TB control programme, which began in 1962, is a complete failure and has in fact made the situation worse by creating a large number of drug resistant patients. The World Bank aided Leprosy Eradication Programme in Bihar, which has 25 per cent of the country's leprosy patients, has also failed to deliver. Lack of infrastructure and failure of the government to hire a sufficient number of health workers has deprived the patients of benefits from the programme.

Even the Pulse polio programme has not succeeded with the ministry quietly extending the deadline for complete eradication to 2005. The programme started in 1977. *But even after 23 years, India remains one of the top three countries to be affected by the disease.* According to the officials, the policy failed as the whole country was not covered and there was a lack of follow-ups. The officials suggested that there should be better co-ordination between the neighbouring countries.

Even after extensive programmes to enhance the health of mother and child, India accounts for 40 per cent of the malnourished children in the world with a estimated loss in the range of $ 10- 28 billion due to lost productivity, illness and death. There is also an increase in the infant mortality rates and even socially active states like Kerala seem to have failed here. Providing better nutrition is the need of the hour as malnutrition is so high that the 60 per cent of the babies would have been put into intensive care units had they been born in a developed country like the us.

Some projects like the integrated Disease Project are being run year after year without scrutiny. Even this year, the ministry has released nearly 50 per cent of its funds to Indian Council for Medical research without waiting for endorsement by the Scientific Advisory Board.

Source: Down to Earth July 31, 2000.

India Tops the Tally in Patent Filing

25.9% of the 1318 patent applications filed in India during 1995 to 1998 in the area of materials were filed by Indian companies and individuals. This turns out to be one area where the share of applications filed by the Indians is so high. In fact, India tops the tally in terms of applications originating from different countries. The study covers metals, alloys, steel, ore processing, composites, semiconductors, superconductors, ceramics, ferrite, sintering, forging, metal coatings and processing methods. By and large polymers and organic chemicals are not included in the study. A large number of areas have been covered by these applications and many different combinations are possible for presenting the results.

1	Total number of applications filed	1318
2	Number of convention applications filed	739
3	Applications filed by Indian companies/ individuals	342

4	Applications filed by Indian individuals	66
5	Indian companies filing 10 or more than 10 applications	5
6	Foreign companies filing 10 or more than 10 applications	11

The filing in this area has grown at about 14% per annum during the period 1995-1998. The top 10 countries, from where such patent applications have originated from 1995 to 1998, are given below:

Country	No. of Patent Applications
India	342
USA	275
Germany	138
France	76
Japan	53
United Kingdom	47
Australia	37
Austria	23
Italy	21
Korea	14

Source: Intellectual Property Rights (IPR), Vol. 6. No. 5-6, May-June, 2000.

India and the World Outlook for World Economy

The global economy is heading for a robust growth, but a number of risks could cloud an otherwise rosy scenario, according to the International Monetary

Chart I: How Economies Will Fare
(percentage change)

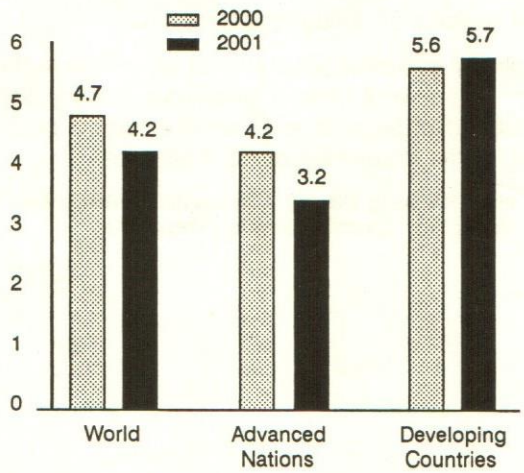
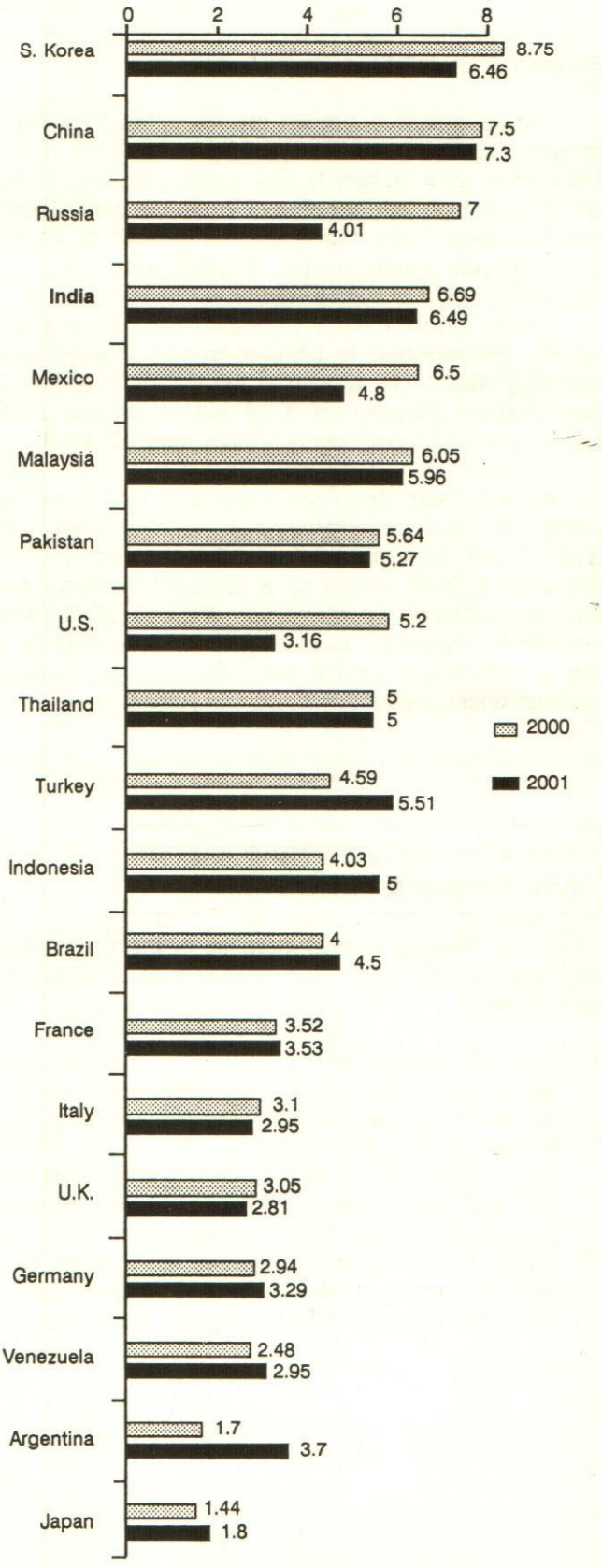


Chart II: Growth Projections
(percentage change)



Fund's World Economic Outlook. The WEO has forecast world growth at 4.7 per cent this year and 4.2 per cent in 2001. This is up significantly from six months ago when the IMF forecast global growth of 4.2 per cent and 3.9 per cent in 2001.

The advanced countries are expected to show a growth of 3.2 per cent next year against 4.2 per cent in the current year **(Chart I)**. The developing economies are likely to maintain growth at 5.7 per cent while transition economies may report a lower growth at 4.1 per cent next year against 4.9 per cent this year.

Growth in the main economies—U.S., Europe and Japan—are reported to be uneven with interest rates deciding prices. The growth in the U.S. is expected to slow down to 3.2 per cent, a full two percentage points lower than the current year's 5.2 per cent **(Chart II)**.

Among Asian countries, *India and China are expected to post remarkable growths at 6.7 per cent and 7.5 per cent this year and 6.5 per cent and 7.3 per cent in 2001 driven by a rebound in agriculture and an explosion in information technology in India.* Growth in Indonesia is expected to accelerate to 4 per cent this year and 5 per cent next year despite political uncertainties.

Source: World Economic Outlook 2000.

The Adverse Consequences of Anti-Dumping in India

There has been a striking increase in the use of anti-dumping in India, which can have serious adverse consequences.

- First, the foreign firms penalized by the AD cases are almost always (as in other countries) those that are most competitive and have the largest and/or fastest growing market shares. This in turn signals other exporters to charge 'reasonable' prices or also face AD actions, and results in a real terms-of-trade loss to India. For a number of products, AD duties have first been imposed on imports from firms in one or a few countries, and then, later, a new case has been initiated and AD duties imposed on imports from firms in selected other countries.
- Second, the AD cases have greatly increased the (already high) protection of industries producing important and widely used intermediate materials (such as basic steel, petrochemicals, other chemicals, synthetic rubber, and synthetic fibres).
- Finally, AD duty, or protection to a single industry in general, implies the adoption of a procedure viewpoint, neglecting both user industries as well as consumers. It is also often the case that AD can reinforce market power—in India, in many of the products on which AD duties have been imposed, there were just one or two producers. It can also set in motion a chain of demands for increased protection, as industries that have to face increased input prices arising from AD duties find themselves becoming less competitive. For example, the imposition of AD duties as well as floor prices and the resultant rise in landed prices on HR coils in November 1998 has resulted in protests by the directly affected CR coil industry, and will also feed into higher costs for a wide range of other steel-using industries. More generally, increased protection and prices of intermediates increases the production costs of consumer goods just as India is rapidly phasing out QRs, and will provide arguments and pressures for higher tariffs.

The present impetus of AD could be stopped or slowed in a variety of ways which are stated as under:

- ☐ Using the safeguards provisions as the main safety valve for responding to protectionist pressures and maintaining them as a temporary, short-term tariff-based instruments to provide extra protection to firms while they adjust.
- ☐ Incorporating a buyer/consumer interest in the AD and safeguards laws and requiring cases to be decided on the basis of the overall economic costs and benefits of imposing duties.
- ☐ Explicitly including an anti-trust type filter in the AD law, which would make predatory pricing and the likelihood of subsequent market power a precondition for the imposition of AD measures.

Source: India Reducing Poverty Accelerating Development: World Bank Study, Oxford University Press, 2000.

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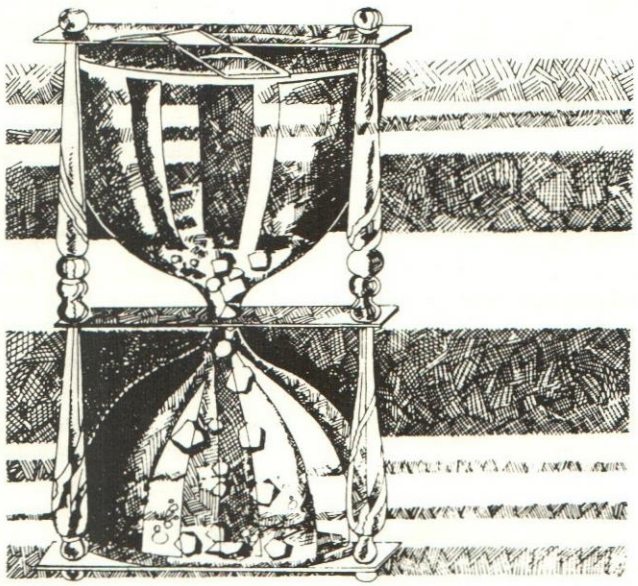
MANAGEMENT THOUGHTS : BY PRAMOD BATRA

One grain of sand at a time, one task at a time



The human mind can hold only one thought at a time.

A person who tries to do many things at the same time, ends up doing nothing. Your undivided attention and concentration in doing what lies clearly at hand will finish the job faster and better, too. Start with the easier tasks; having tasted success you can accomplish the difficult ones with added confidence.

□ Think Inc., Batra

Book Reviews

Industrial Relations and Human Resource Management in transition *by J.S. Sodhi,* published by Shriram Centre for Industrial Relations and Human resources, 1999, pp. viii + 374. Price Rs. 300.

The book is based on the compilation of case studies by the author in the field of IR & HR in Indian Industries. He has elaborated on the overall policy changes in last few years, difficulties in implementation thereto and how they were taken over by the management in order to sustain and grow in the era of liberalisation. The book is divided into 11 chapters and 4 large annexures where 2 companies in each industry are analysed.

The author discusses HR concepts like positive work culture, teamwork, Kaizen, empowerment, etc. which are burning topics today and have changed the definition of IR in the current scenario. The integration of technology and HR strategies/practices in order to utilise the fullest organisation potential have been emphasised. He has given various examples from different sectors of industry to support his observations in context to Indian economy. Various objectives related with the study are described besides the methodology of study, rationale behind identification of the four industry-groups and company details in brief. The methodology adopted is legitimate and various sources of information, both primary and secondary, have been taken into account while presenting the facts and findings.

Case studies of selected organisations namely Maruti Udyog Ltd., Escorts Ltd., Oriental Bank of Commerce Ltd., ABC Bank, Electronics Corpn. of India Ltd., Modi Xerox, North East Garments and Silicon Garments have been presented. The case studies provide a detailed background of the company, economic environment and corporate strategy, industrial-relations, human resource management practices and related strategies, moves to mend important anomalies in the functioning of management and supervisors. The author has done extensive study and analysed key issues faced by these organisations which have helped them to acquire their current position in the market. Some core competencies like communication process in organisation, personnel policies, etc. are analysed and the outcomes arrived at by the author are of immense importance to guide the followers and new entrants to learn how change is brought about. The author has given extensive comparable data bank to justify his observations.

Conclusions from the case studies of various companies are summarised in chapter eleven. He has enumerated the change in the attitude and ideologies of trade unions, management and the Government also. He also provides some of the best practices regarding various policies and framework changes adopted by different companies. Transparency in decision making and functioning with the involvement of all employees including workers at the shopfloor have become a matter of concern toward creating sound organisational climate. The author has stressed on the need to change the organisational Policy Framework and has given wide descriptions on them about participation among various rungs to move for change. He has stressed on the need of benchmarking Indian companies. "Learn from success" has been the motto of the world today and in tune with that, the concept of benchmarking and compilation of the organisational literature, data etc. is a matter of great use for the HR managers.

The author concludes the compilation with four annexures giving details about the industries discussed in the study namely Automobiles, Banking, Electronics and Garments. These annexures provide details of the background, past, latest developments, important events, growth trends and other features of each industry.

In the study the author has stressed on proactive approach to deal with competition and day to day changes to fulfil customer demands. Supported by case studies he has shown the fact that "IR time is over and now is the time of HR – the proactive approach". Training and communications are the key factors for development of positive work culture. HR people are

awarded with due importance and are now dealt at very high levels in organisations. The third party, Government, is pulling its hands off day to day disputes between unions and management and disputes/grievance handling has become more intra-company issue which require Unions and management to behave more responsibly now.

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The New Manufacturing Architecture *by Prof. B. Mahadevan*, Tata-Mcgraw Hill, New Delhi, 1999, p. 256, Rs. 295.

Change is the law of nature. Management of change, is necessary for assimilation over time. But one thing is certain, change we must, when required. In the industrial perspective, there are suppliers, producers, distributors and customers. But the producer has to accept the major part of the challenge of change, to satisfy the requirements of the customer, for sheer survival.

Manufacturing organisations have long been subjected to the forces of competition in the changing environment. Of late, the competition has become global and also, not only the number of newcomers in the market in several sectors has increased, but there has also been a substantial fall in prices of goods and services, besides reduction in the times of delivery to the customer. The author felt that this necessitated changes in structure and linkages in industrial organisations and had interactions with executive of several manufacturing organisations in India.

The author, who is an Associate Professor at IIM, Bangalore, communicates his original findings and visualisation of a new architecture for manufacturing organisations, which is the central theme of this book. It aims to bring the customer in focus, as well as provide a suitable place to the suppliers. It is expected that the overall framework suggested in this book, will help in better organising the various activities and personnel related to production and distribution of goods and services. It will thus lead to optimisation of production through reoriented shopfloors, structure and systems.

Besides preface, it has 8 chapters contained in 3 parts, followed by notes to the chapters (a total of 56 for 8 chapters) and subject index in 4 pages. The new manufacturing architecture is defined in introduction to Part I, its designing is explained in introduction to Part II and managing the transition from design to reality is covered in introduction to Part III.

The author states that all the five layers in an organisation viz. customer, core manufacturing, manufacturing support, innovation and supplier, must mesh with one another, complement each other and create a structure and system that works for the customer. New challenges are then discussed; with the domestic and global markets getting integrated, buyers of industrial goods and services look for potential suppliers in any part of the world. Manufacturing architecture provides an overall framework and aims to eliminate the incoherence in material and information flow across the five layers. The author states that the functional layout in manufacturing organisations has blunted the competitiveness of products and services offered.

A blueprint of the new manufacturing architecture is provided – many small units are formed within a plant producing a particular product. Each supplier (i.e. a group of people working in a cell) is identified with a part of the conversion process and is made responsible. The flow of the product is better and visible. Groups of people in each cell have ownership and involvement. The effectiveness of the final architecture depends on defining of these groups and end products. The author suggests three options or combinations thereof, to gear up the manufacturing architecture viz. Product oriented Plant (POP) Architecture, Manufacturing similarity oriented plant (MOP) Architecture and Turnover oriented Plant (TOP) Architecture.

The author talks about integrating the supplier layer, with other layers of an organisation, developing performance measures that promote co-partnership and opening up new communication channels, with the suppliers etc. Benefits of the new architecture will be lost, if it is not implemented properly. All direct stakeholders of an organisation should perceive excellence in their own perspectives. This is discussed in Chapter 6. The art of transforming the blueprint into reality is next discussed. The benefits of the change to new manufacturing architecture should be quantified and communicated to all concerned. However the most important requirement of the change process is the need to succeed (esp. during its early stages) within a reasonable span of time.

The author elaborates on preserving the newness of the manufacturing architecture, making changes, as and when required, generating required capabilities and inculcating learning "as a way of life". The book contains case studies from International and Indian Companies. There are 39 figures (out of which 12 are coloured) appealing and impressive.

However, there are no references, no consolidated

list of figures, tables and boxes (case studies), chapter-wise centrally all at one place, no glossary of important terms and abbreviations all at one place and no request in preface to the readers to send their valuable comments. Summing up, the author has made a valuable contribution by writing this book. It is likely to be very useful for all those who are concerned with making business competitive.

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Economic Restructuring, Technology Transfer and Human Resource Development *by B.R. Virmani and Kala Rao,* Second edition, Response Books (A Division of Sage), New Delhi, 1999, p. 323 hard, Rs. 450.

The key rationale of adopting globalisation policy by any nation is to fully utilize its capital and human resources as per their potentialities so as to enhance quality and reduce costs of goods and services produced. This is done by putting pressure of competition on the manufacturers and service providers. Competition exacerbates the need to practice professionalism by them in all spheres of business organisation and management. The Asian Tigers i.e. Taiwan, Korea, Singapore and Hongkong, and Asian Cubs i.e. China, Malaysia, Thailand accepted globalisation philosophy early enough and undertook major changes in their market structure to become globally competitive and export-oriented. In the developing world, one of the key reasons for adopting globalisation is to seek technological upgradation. There are various ways through which upgraded technology is imported and imbibed in local realities. These include: direct investment in technology by multinational corporations (MNCs) so that they can sell their products on more competitive terms; local operators entering into joint ventures with technology-rich foreign partners; its direct purchase by the local manufacturer; and collaboration agreement with a foreign supplier for import and assimilation.

If economic restructuring is not supported by creation of facilitative environment for technology import and upgradation, it will not deliver the intended results. The globalisation syndrome also involves devising policies that are conducive to human resource development (HRD) at the macro level so as to meet the needs of upgraded technology in a cost-effective manner. These decisions need to be taken at opportune moments.

The book under review discusses the issues involved in integrating economic development, technology and HRD. It is based on a first-hand comparative study by the authors involving four countries: Singapore, Malaysia, Thailand and India. It focuses on analysing organisations in these countries, which have restructured at different points of time to usher in technological and other changes. The authors have successfully demonstrated that for attracting foreign investments a country needs to develop infrastructure and create favourable conditions so that technology can be successfully imported and absorbed. And, unless appropriate HRD policies supplement the technological upgradation attempts, intended benefits cannot be derived.

The present book has come in its second edition. The first edition was brought out in 1997, which had cautioned against the possibility of a financial crisis in East Asia. The recent East Asian financial crisis has led them to bring out the present edition. The authors claim to have updated the statistics presented in the earlier edition. The analysis of this crisis is intended to raise caveats for a country like India as to how it can save itself from similar embarrassments. The book is divided into 12 chapters, one each being on Malaysia, Singapore, Thailand and India (Part II). Part one consists of two introductory chapters. Four chapters in Part III present organisational case studies, and the final part draws out lessons and directions for the future.

The book, no doubt, is highly informative about the relationship between economic development and technology transfer in general and about the position in this regard in the countries focused in particular. It has been written in a jargon-free manner, and therefore can be of considerable interest not just to the specialist but to the lay reader as well. The presentation of the formulations in a remarkably lucid manner makes the reading far more interesting. The four case studies presented in it contain very interesting material on factors that can facilitate and hinder import and absorption of technology.

However, the discussion on HRD is not exhaustive enough so as to justify the inclusion of this term in the title of the book. If the book had been titled "Globalisation and Technology Transfer", perhaps that would have been fairer, given its contents. The chapter on India could have presented the history of technology policy in greater detail so as to relate the chronological developments in it with the developments in the political economy. Some of the data presented in this second edition is only till the year 1995–see, among others, for example, the position of foreign exchange reserves (p. 152); the rate of economic growth (pp. 158-59), employment in export zones (p. 161). While comparing the industrial relations situation in India and the other three

countries, one cannot uncritically eulogize the East Asian IR models. Those models are quite authoritarian and unitarist. The labour relations model in India has succeeded a good deal in creating awareness of labour rights among labouring classes as per the constitutional proclamations. An enlightened society partly sacrifices efficiency considerations for promoting 'social justice' and 'workplace dignity'. Such a configuration of productivity, performance, and justice dispensation may be preferable to purely unilateral rationality of managerial prerogatives.

Overall, however, the book is a very important addition to the literature on the subject. It has convincingly argued the need to take safeguards for preventing the recent East-Asia like situations in the Indian financial market.

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Agricultural Research and Extension Interface in Asia, 1999, Asian Productivity Organisation, Tokyo, p. 214.

The book under review is a compilation volume of the study meeting on agricultural research and extension interface in Asia organised in India from Dec. 16 to 21, 1997 with a view to specify the major issues pertaining to the apparent weak linkage between agriculture research and extension activities and to identify measures for strengthening such linkage in member countries.

The book is divided in four parts, Part one deals with the summary of issues and recommendations. The second part includes five resource papers–two from India and one each from Japan, the Food and Agricultural organisation (FAO), Rome and the Consultant Group on International Agricultural (CGIAR), Washington, DC. These papers are intended to provide a clear theoretical background of the subject. Country papers of 12 member countries are discussed in third part; part four has the list of participants, resource speakers and Programme activities.

Recommendations on various aspects like Structural, Organisation and Policy aspects, Institutional linkages, Information technology, Technology assessment, Monitoring and Evaluation, farmers participation, Human resource Development and Gender Intervention are explained thoroughly.

Rita Sharma in her resource paper 'Agricultural Research and Agricultural extension–Indian Experience' highlights the second-generation effects of green revolution in India, changing role of agriculture extension using various programs, constraints in adoption and institutionalisation, restructuring public extension services and innovation in technology dissemination.

Dr. Manuel M. Lantin in his well-prepared paper 'Organisation Linkages between Agricultural Research and Extension' brings out the importance of research and technology transfer interface. Lack of relevant available technology for management of common farming systems associated with poor linkages between researchers, extension staff and farmers are major bottlenecks in Agricultural Technology systems (ATSs). Human resource development is another significance tool for agricultural research and extension. Mr. Sousuke Haga in his paper 'Human Resource Development for Agricultural Research and Extension' examines such issues giving example of rice farming in Japan. He stresses on empowerment of researchers, extension workers and farmers in order to enhance agricultural productivity.

Challenge of transformation for conventional agriculture extension services is the theme of Dr. Kalim Qamur's paper 'Effective Information Systems for Technology Transfer'. The author points out that conventional extension organisation in developing countries cannot continue with the passive transfer of information to farmers on improved varieties, inorganic fertiliser and pesticides application etc. B.S. Hansra on his paper 'Approaches for technical Diffusion and Adoption' seeks to examines the efforts in India and abroad for shortening the process of technology generation, diffusion and adoption.

The third part of the book comprises country papers, which provide good idea on assessing the current agricultural research and extension activities in member countries, issues and problems concerning the linkage between research and extension in agriculture and ways of enhancing such linkages. Md. Mozammel Hoque in his paper on Bangladesh focuses on the existing agricultural research schemes of Bangladesh–strategies about agricultural research and extension, farming systems mechanism, research extension linkages and sensitivity training are some of the ideas, which need to be propagated in Bangladesh. Charlene S.L. Yen in his paper on ROC focuses on the framework and management of agriculture and extension. He argues that strategies should be made for strengthening technical development, improvement in extension of agricultural technology and for actively developing biological technologies.

Ravinder S. Saini in his paper focuses on research-extension infrastructure and linkages and new initiatives taken by Ministry of agriculture, Government of India to consolidate the gains from World Bank assisted projects on agriculture and extension. Gopal R. Desai provides a brief review on present setup of agricultural research in his paper on India.

Eko Iegowo in his paper on Indonesia presents a thorough background of agricultural research and extension, vision of agro technological transfers in 2000 and development of superior commodity based farming system to create a modern, integrated and efficient agriculture system. Mahmoud Damadzadeh's paper on Iran concerns organisation structures, management and agriculture research priorities. He advocates research extension linkages and assessment of performance of agricultural research and extension. Country paper on Malaysia by Abu Hassan B. RJ. Ishak provides brief review of Socio-cultural and economic structure of Malaysian agriculture. He stresses the need to manage county economy properly with the support of extension services as well as R & D for agricultural development.

Begz Dorj paper on Mongolia concerns the agricultural environment, land resources, soil, research institution and the extension services. Muhammad Aslam Sadiq's paper on Pakistan places emphasis on the setup of agriculture extension, trends in allocation of public and private funds, performance of agriculture extension and research linkages. Jovita M. Corpuz in his paper on Philippines presents the technology development and transfer systems, R & D prioritisation and evaluation, strengths and weakness of the technology delivery system in Philippines. Country paper on Srilanka by Chelliah Sivayoganathan emphasises the organisation of agricultural research, agricultural extension and research extension linkages. Tuwanan Panityothai's paper on Thailand concerns organisation structure and management of research at national and regional level and recommendations on the effect of agricultural linkages. This book will enable researchers, extension agents, farmers, and other stakeholders to jointly develop and implement programs of sustainable rural and agricultural development to their mutual benefit.

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Managing Constant Change: Insights and Capabilities *by P.N. Rastogi,* MacMillan India Limited, Delhi, 1999, p. 293, Rs. 285.

In a highly complex, increasingly uncertain and rapidly changing environment of global economy, trade and industry, managing change is not an option, it is an imperative for business enterprises. The theme of organisational change and transition, has received considerable attention from both management thinkers and practitioners. Though a relatively large and rich body of literature exists on this theme, the present volume is a welcome addition as it contains latest and best in management thinking and research.

Today's knowledge, technology and managerial practices, that provide competitive edge, are becoming short-lived. Techno-scientific, geo-political and socio-economic trends and forces affecting organisations, are increasing. The rate of change is consequently intensifying. How organisations respond to this fast-paced change, will largely determine their survival and success.

The author advocates, in this book, a new approach, focused on a continuing enhancement of the resilience and viability of the organisation. An enterprise needs to continually build up its capacity to cope with the stresses and strains of incessant change in a resilient manner; and convert challenges into opportunities. They cannot be properly managed in terms of fixed plans towards reaching a pre-specified goal state. The best, or most appropriate course of action, open to an enterprise under these circumstances, is to cope with change in terms of a set of performance enhancing generic capacities. The latter would serve to strengthen the viability of the organisation, and amplify its capacity to cope with the emergent and emerging, anticipated and unexpected, ordinary and extraordinary change situations in a rapid flexible and competent manner.

Organisational agility is apt to enable an enterprise to transform the nature of competition within an industry through strategic flexibility. Strategic flexibility implies an organisation's capacity to switch gears—from, for example, rapid product development to cost leadership—relatively quickly, with ease, and minimal resources. It is an outcome of building generic capabilities that are central to the organisation's competitive resilience and long-term success.

The book is divided into two parts. Part I is subtitled as 'Insights' and consists of chapters one to three. All the three chapters in this part, elucidate and highlight the concepts, perspective and themes, that together provide the vital insights and premises needed towards managing continuous change. Part II is subtitled as 'Generic Capabilities', and consists of chapters four to twelve. These chapters focus on the specific generic capabilities that need to be cultivated and enhanced continually towards mastering the incessant challenges

of change. At the end of each chapter, points to ponder by the readers is given to facilitate the subject for implementation.

Chapter one delineates the nature and dimensions of today's fast-changing, complex, uncertain and highly competitive, global environment of business. The challenges call for a change in mindset of today's managers. They also call for learning and internalising a set of premises that define the nature of contemporary realities of business and the managerial requirements pertaining to them. The theme of the managerial mindset and premises is the focus of chapter two. Chapter three elucidates the concept and characteristics of organisational vision, as well as, the nature and the process of envisioning a desired future.

Chapter four outlines the need for, the nature of, and the requirements concerning, the radical redesign, or reengineering of core business processes. Chapter five extends the theme of process redesign towards creating the fast cycle capability of the enterprise. Chapter six elucidates the nature, and the rationale of the concept of core competencies and core service functions capabilities for providing the firm with a strategic focus, and difficult-to-imitate source of competitive advantage.

Chapter seven focuses on nature and significance of the strategic management of technology. Chapter eight extends this theme by focusing on the power and potential of software, towards facilitating innovation and problem solving in new and more effective ways. Chapter nine highlights the important advantages of synergy and complementarities obtainable by a firm through its cooperation with other firms including suppliers, customers and competitors. Chapter ten calls for tapping the powerful potential of the creativity and talents of the firms's human resources. Creativity provides a non-price resource of high competitive value, for the enterprises. Chapter eleven is concerned with the crucial theme of redesigning the entire business system of a firm, in response to environmental discontinuities. Chapter twelve underscores the nature and role of knowledge, as the quintessential resource, for problem solving, adaptation, growth and development. Exploitation of knowledge as such a resource calls for the transformation of a firm into a learning organisation.

The book concludes by highlighting the nature and significance of synergies and ethical values, towards the development of organisations, and their capacity for successfully coping with change in a continuing manner. The author has very successfully brought together the various aspects required for managing change. It should be quite useful to managers of industrial enterprises in general and administrators involved in revitalising the organisation in particular.

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Marketing of Information Products and Services: A Primer for Librarians and Information Professionals, *Edts: Abhinandra K. Jain, Ashok Jhambekar, T.P. Rama Rao and S. Sreenivas Rao,* published by: IDRC, Ottawa and Tata Mc Graw, New Delhi, 1999, p. 462.

We are in information era and information is being recognised as a critical resource for socio-economic development of a country. Libraries and information centers play a major role in this field of development. There is no organisation in this Universe, which can survive without information. The various functions of Information centers are to collect, collate, repackage and disseminate knowledge to the user community. Computers and networking mechanisms have tremendously enhanced information storage, retrieval and dissemination capabilities. But, for the implementation of modern IT tools, libraries and information centers require a significant amount of investments in infrastructure. There is, however fund crisis, especially, the government's financial assistance is declining. For today's libraries and information centers to survive, they have to be self-sufficient. To create a niche in the society, librarians and information managers have been forced to generate revenues not only for acquiring state-of-the-art technology but also for their own survival. Library and information centers are service based organisations and the goal of the professionals is to render high quality products and services to the right users, at the right time.

Looking at the current demanding situation, this book is a commendable effort by the authors and proves to be a resourceful guide for those who already exist in the market or are planning to invade the competitive market. There is nothing called 'free of cost" product, every product comes with a "price tag". The "users of information have become customers" and they are ready to pay the price for value added information, quality products and services. But all these require an excellent well-planned marketing strategy. This market guide contains nine chapters and two case studies meticulously covering all possible and probable aspects of marketing e.g. concepts, tools and techniques relevant to library and information centers.

Chapter 1 emphasises the need for adopting a marketing approach by librarians and information managers. Prof Rao highlights the four major challenges such as varied demands of clientele and their rising expectation levels, increase in the capital cost of information and information technology, drying up of public sponsorship and complexity in ways of identifying clients and requisite service to them. This chapter covers areas like barriers to marketing practice, challenges faced by the library professionals of today and tomorrow, drawing upon an earlier research on assessment of needs of management information. In Chapter 2 Prof. Jain and Prof. Rama Rao explain various concepts of marketing management and how they are useful and relevant to libraries and information centers. They discuss the key purposes of marketing–how the needs, wants and customer satisfaction level can be measured, and how organisations can be oriented and embraced towards marketing. Ms Gumbs describes in Chapter 3, the marketing plan developed by the Technology Information center at the Argus Institute of Technology. She also provides the guidelines for developing a marketing plan and conducting a marketing audit. The chapter also describes the application of SWOT analysis in justifying the performance measurement. In Chapter 4, several key concepts are discussed such as product or service planning, product life cycle and product positioning. Product Life Cycle indicates the dynamics of the market due to changes in the preferences of customers, technology improvements and competition. Prof Koshy explains the meaning of products and services in the context of libraries and information centers, and provides guidelines for planning a portfolio of products and services. He elaborates on the concept of Product Life Cycle (PLC) and its implications on stages for marketing strategy. Chapter 5 discusses price—one of the four market decisions. With the example of National Information Center on Management (NICMAN) at IIMA, they explain the various considerations while taking pricing decisions. Promotion of an information product or service is one of the essential communication processes to let the prospective client or buyer become not only aware of the new products and services available, but also to motivate him/her to actually subscribe to the products or services. Therefore, among all "Ps" of Marketing, the strongest pillar is the "Promotion of Products and Services". In Chapter 6, Prof Sreenivas Rao discusses various attributes of promotion with examples from various libraries and information centers, such as INSDOC, ICRISAT, and CEIS; and requisite guidelines for making promotion decisions. Chapter 7 discusses the rationale, procedure and steps in conceiving, designing and introducing new products and services useful for a library or an information center. Several reasons outlined in this chapter suggest a strong need for libraries and information centers to identify opportunities for new products and services and then introduce them. Marketing Research is an important function and involves several steps; each step should be thoroughly studied and evaluated. The data that is collected should be non-biased. Chapter 8 describes the contents of a research plan and the criteria to be used for deciding research designs and data collection approaches. It also provides a brief description of some widely used research designs. Use of sophisticated research methods like focus group discussion, large scale surveys and experiments for making strategic decision may be left to specialist agencies till librarians gain requisite insight.

Going from no charge to payable services represents an important shift–in some ways, the customer and customer satisfaction become the ultimate goal behind all decisions and activity. It is important to realize that such a change does not happen overnight or without the support of the whole organisation. Dominique Beaulie in Chapter 9, describes how the Center de reserche industrielle du Quebec switched from free service to charged service and brought about changes in the outlook, attitude and structure of the organisation to achieve a marketing orientation. Lastly the book presents two case studies namely "Caribbean Energy Information System (CEIS)" by Ms Whyte and Prof Sreenivas Rao and "Asian CD-ROM on Health and Environment" by Mr Chin and Prof Jain. The major thrust of CEIS is energy related information collection, storage and utilisation for optimum conservation and utilisation of the region's energy resources. The other case study presents the market research conducted for assessing suitability and utility of CD-ROM publishing, a modern Information Technology tool, and the process of developing suitable marketing plans for the same in developing countries. This guide can be used as both textbook or reference to draw up marketing strategies and plans, and also as a training manual in educational and training programmes for librarians and information managers.

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Agricultural Land Tenure System in Asia and the Pacific edited *by Brian Humphries,* Asian Productivity Organisation, Tokyo, Japan, 1999, pp. 301.

The book is based on the seminar on Agricultural Land Tenure System in Asia and the Pacific organised by the Asian Productivity Organisation (APO) and

hosted by the Ministry of Agriculture, Forestry and Fisheries, Government of Japan from August 11-20, 1998 in Tokyo. Fourteen participants from the member countries and five resource speakers participated in the seminar. The objectives of the seminar were: to assess and identify major issues and constraints in agricultural land tenure systems; and to suggest measures to enhance their contribution to improving productivity. The book is divided into four parts. The summary of findings is given in Part I, five resource papers are discussed in Part II, fourteen country papers are presented in Part III and appendices are given in Part IV.

Simon Keith has raised an important issue of taxation in his resource paper. He has highlighted that property taxes, usually a local government tax, typically yield less than five per cent of the total tax yield of a country. Only in U.K., U.S.A. and Australia do they yield significantly more. But although their effect is small in national term, they are important locally. Taxes can have an effect on land tenure–good or bad. The effect of property taxes on land revenue is not likely to be negative. It is often said that the incidence of property tax encourages more productive use of land and discourages speculation. It is possible to over emphasise these aspects. However, property tax does tend to make access to land easier for the less wealthy because the ultimate burden of the tax falls on the owner. The tax has the effect of reducing the market value of land and thus making it easier to purchase. This effect is usually not very noticeable but the converse is more apparent. Where there is no tax on property, there does seem to be a tendency for land ownership to become more concentrated in the hands of the wealthy. These observations of the author may be a lesson for India. Most of the State Governments as well as the Government of India are facing acute financial hardships. Resource mobilisation should be the number one priority in the country. Agriculture sector can also contribute in this regard.

Brian Humphries has discussed the importance of cadastral systems in his resource paper. Because the legal, historical, cultural, religious, social and political characteristics of a country differ from others, no two cadastres will be the same, hence, transfer of a system from one country to another is usually not possible. However, a key component of any cadastral system is an efficient method of registration of interests in land. Registration of titles is proven as an efficient method. While computerisation is not of itself essential in a developing country, it brings obvious benefits. However, the hasty introduction of computerisation may exacerbate existing problems. In India, some State Governments have recently introduced computerisation of land records but this process should be a smooth one.

Ikuo Shimoji studies the agricultural reforms and changes in the structure of ownership of agricultural land in Japan in his resource paper. Through the agricultural land reforms, the Japanese Government procured about two million hectares of tenant land and about 400 thousand hectares of pasture land by 1950 and sold this land to farmers and particularly tenant farmers, toward promoting independent farming. Moreover, the government procured 1.3 million hectares of untilled land and sold this to create independent fanning. The ratio of tenant land was about 46 per cent before the agricultural land reform but in 1950, after the reform, the ratio decreased to about 10 per cent, farms with the majority of land being leased land. Landlords opposed this agricultural land reforms in a variety of ways. But the impact of agricultural land reforms on Japanese agriculture and rural areas was large and an overwhelming majority of farmers became independent farmers, motivated towards developing productivity and contributed greatly to the development of the Japanese economy.

Nobuyuki Kawagoe has examined the agricultural system in Japan in his resource paper. The author gives details of laws concerning the agricultural system, definition of agricultural lands and other important terms, restriction on cancellation of lease, guidance on farm rent, mediation of conflicts regarding use of agricultural land, etc. This paper is more technical in nature from the legal point of view. It does not have wider policy implications for other developing countries of Asia.

Akimi Fujimoto has studied agricultural land tenure and productivity enhancement in South East Asia rice farming. The author has critically brought out that agricultural development had taken place by following two methods: extensification and intensification. The former path refers to the development of new agricultural land by clearing forest or reclaiming swamp areas. As population increased, the demand for food production increased and larger area of land was brought under cultivation. Land development was actually the main means of increasing agricultural production for many centuries, even though some technological improvement was probably carried out. However, land resources are limited and new land development has almost reached the limit in many countries. This has increased the relative importance of the other path, intensification in agricultural technology, in many countries. The establishment of intensive farming by heavy dependence on chemical inputs such as chemical fertilizer, herbicide and insecticide, had certainly promoted food production in response to increasing demand. However, it has been recognised that such intensive technology became also responsible for en-

vironmental degradation such as water pollution and pesticide residue in soil and water. The problem of negative environmental impact of agricultural technology is actually more acute in upland farming than rice farming. This has led to a global recognition of the need for sustainable agricultural development.

In the country paper of Bangladesh, the author has concluded that the existing land management system as well as agricultural land tenure system are not conducive to the establishment of efficient property markets. It is operating at a low level of efficiency, it does not adequately respond to the present needs aside from the expectations and challenges of the 21st century. India's country paper was presented by T. Haque. During the year 1950-51, about 38 per cent of operational holdings in the country were marginal holdings which operated only six per cent of the total area, while 5.4 per cent large farms above 10 hectares cultivated 34 per cent of the total area. According to the 1990-91 agricultural census, the proportion of marginal farms increased to 59 per cent which shared about 15 per cent of the total areas. But large farms formed only 1.6 per cent of the total holdings and 17.4 percent of the total area. Still about 8.6 per cent large and medium farms at the top bracket cultivated nearly 45 per cent of the total land. Thus, even if we compare the pre-land reform year of 1950-51 with 1990-91, the series of land reform measures during the past five decades, do not seem to have improved the pattern of land distribution. In fact, the pattern of land distribution seems to be more skewed in recent years. These facts are an eye-opener to the policy makers of India. The process of land reforms has been slow in the country on account of various social, economic, political, administrative, legal and other reasons.

Similar to India, land ownership distribution is highly skewed in Pakistan. A small number of land owners own large extent of land whereas actual land cultivators own very small share; about three per cent land owners own more than 31 per cent of the total land as against 65 per cent farmers owning only 15 per cent of the total land. Ninety-five per cent of farms fall in the small and marginal holdings categories. The uneven distribution of land with high concentration of land-holding in the hand of few landlords is significantly affecting the productivity and economy, with lack of attention resulting in poor farm output and low yields. The majority of farming families are living under subsistence level. Besides small size, the fragmentation of farms into two or more separate holdings is a significant constraint on agricultural production. Fragmentation comes about primarily through sub-division for inheritance and acquisition through marriage, purchase, etc. Several efforts have been made for land consolidation. The success of the programme is not visible.

The authors of other country papers have also raised similar issues relating to agricultural land tenure system in their respective countries. Most of the Asian and Pacific countries have initiated the process of land reforms in the post-Second World War period but the implementation pace has been slow. In some countries, the land record system is not efficient.

The editor could have easily deleted the irrelevant portions from the book. For example, there is no requirement of the section 'Nutritional Needs and Food Supplies' in the country paper of Pakistan at page 252 and 253. Similarly, in the country paper of Sri Lanka, ethnic distribution of population is given at page 269. It has no relevance with the land tenure system in Sri Lanka. At the same page, there is discussion regarding official language of Sri Lanka. It has nothing to do with the objectives of the seminar on the basis of which the book has been published.

Overall, the book is valuable. It contains useful information regarding agricultural land tenure system in Asia and the Pacific. The book will be useful to the policy makers, administrators, agricultural scientists and farmers. APO is to be congratulated for bringing out this excellent publication.

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