Productivity: A Key Factor for Market Success

Horst Wildemann

In the rapidly changing milieu of today's business environment, productivity is not merely a ratio of input to output. The author recommends that various other performance indicators should be integrated into the productivity analysis and suggests that administrative processes should receive more attention.

Horst Wildemann is Professor in the Centre for Industrial Economies, Technical University, Munich Leopoldstraße 145, 80804, Germany

Productivity is a classical dimension of success and control, besides other key success factors such as quality and time. Productivity management aims at improving the efficiency of used manufacturing resources by identifying wastes within the processing chains, and developing measures to improve productivity (Heinen, 1983, Wilden, 1989).

In practice, the importance placed on "productivity" is not constant but dependent on cyclical changes. The cyclical emphasis on targets requires a periodical reorientation of the entire corporate organization, which may cause time and cost-intensive problems of adaptations. The time needed for the readaptation of targets and the varying speeds of implementation within the organizational units lead to disorientation in the interplay of corporate market demands and product life cycles. Resulting in conflicting objectives and contradictory behaviour of the organizational members (Cameron, 1986). Irrespective of changing market situations, productivity should constantly be given high importance so that a continuous, long-range improvement process backed by the employee majority can take place.

There have been various studies on the measurement, analysis and enhancement of productivity, the scope of these studies extends from an overall socio-economic level to the individual work place. However, a uniform understanding of the term "productivity" has not yet been achieved (Schaper, 1984). Therefore, corporate decision makers lack the foundation for judging the productivity figures as well as effective strategies for raising productivity (Hayes & Clark, 1987). The concept of productivity can be derived from the purchased input, the chosen aggregation level, the time factors and the production process (Hahn & Laßmann, 1986).

When determining productivity, difficulties in allocation and comparison arise from the different dimensions of input factors. For that reason, the input is differentiated

according to the single factors within partial types of productivity, thereby deliberately neglecting the dependence between these factors (Heinen, 1986). Capital productivity is defined as the ratio between the units produced and the production equipment used, as reflected by the machine operating time. It refers to fixed assets, in particular to machinery and equipment necessary for production. On the other hand, material productivity describes the ratio between the units produced and the use of material per unit. The most common criteria however is labour productivity, which evaluates the effectiveness of manpower employed by measuring the output per worker or per working hour. There exists interdependence between the factors of these various concepts of productivity.

Management based on productivity analysis does not necessarily lead to an optimal use of resources within the company. The reason is that productivity analysis usually considers only the effects of input and output within the direct manufacturing sector. In this technical sphere it is relatively easy to identify cause and effect relationship and to find an analytical optimum. In the sphere of actual manufacturing, German industry can be considered among the most productive industries world-wide. However, it may not be the case when including the indirect sectors. It is therefore essential to include the indirect sectors and their performance goals in any productivity analysis.

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In recent years, the range of services offered by many manufacturing firms has changed from the simple production of parts to overall problem solving for the customer. Ordinary productivity analysis does not reflect this changed performance requirement through corresponding performance indicators. In addition to the efficient use of capital, labour and material within the manufacturing sector, factors which determine efficiency for the additional performance in indirect sectors have to be considered as criteria of partial productivity. Previously the maximization of the quantitative input/output relationship within the direct sector automatically met the company's formal objectives. Today, however, there are additional performance goals which should determine the use of resources and should be taken into consideration when assessing internal achievement. For example: If a customer demands a problem solution which is an essential component to the manufactured product's innovative performance, the efficiency of the R&D sector should be regarded as an additional productivity factor. If the core business of the enterprise is decisively influenced by service performance, the indicators of service productivity should be incorporated.

After the analysis of single factors, the choice of an aggregation level forms an additional dimension in the customary analysis of productivity. Often pyramid-like reference number systems build the foundation for productivity measurement. These systems are based on the examination of cost centers, whose results are condensed into productivity by sectors and finally transformed into total productivity; corresponding either with individual products or with the enterprise as a whole. The pattern of the reference number system is a reflection of the company's organizational structure. This results in actual business processes, which mostly run horizontally (i.e. cross-departmental and functional), to the organizational structure, being not represented properly in the system. However, the efficiency of carrying out business processes is the decisive criteria for internal efficiency, organizational aspects are gaining increasing importance in productivity management. The relatively stable structure of internal tasks, functions and organization in the past, which made possible the comparative analysis of productivity figures over long periods of time, is being replaced by a constant change of corporate organization. This greatly restricts a comparison between productivity figures. Hence the necessity to define productivity figures on the basis of permanent and consistent processing chains, independently from changing organizational structures. This third dimension of the concept of productivity is defined by the reference to time. This means that productivity figures are time-oriented, such as productivity per day, month or year.

Strategies to increase Productivity

There are three basic strategies to increase productivity (Fig. 1). Strategy I aims at maintaining performance while reducing the use of resources. Principally, this strategy is applied in situations of stagnating and declining markets and strives towards the reduction of work staff, the amount of capital invested or the amount of material used. Thus, increasing productivity requires a reduced number of employees, which often leads to potential conflicts and loss of time due to the short and medium-term inflexibility of input factors and the company's social goals.

Strategy II aims at increasing output with steady input. Due to various inflexible factors such as long-term

contracts to purchase materials, irreversible decisions of investment and the size of workforce which cannot be adjusted at short notice, output maximization seems to be the only possible way to increase productivity directly dependent on market cycles. Because of the usual practice of maintaining reserves in the form of qualitative and quantitative overcapacity, Strategy II does not necessarily lead to the improvement of production processes, but must be considered as a tool to intensify efforts and utilize capacities. Consequently, there is generally no real improvement in the internal processes. However, limiting the change to a single parameter preserves traditional manufacturing concepts and their deficiencies.

tion process between input and output. Strategy III follows this view. By permanently improving business processes the key factors for market success are so positively influenced that additional demand is created and productivity raised.

These strategies differ greatly in their procedures. Strategy I reveals savings under an *ex-post* analysis. Future targets are defined by examining the deviation between the realized factor application in the past and the analytically or empirically possible minimum factor application. The main weakness of this procedure is the projection of targets on the basis of the composition of

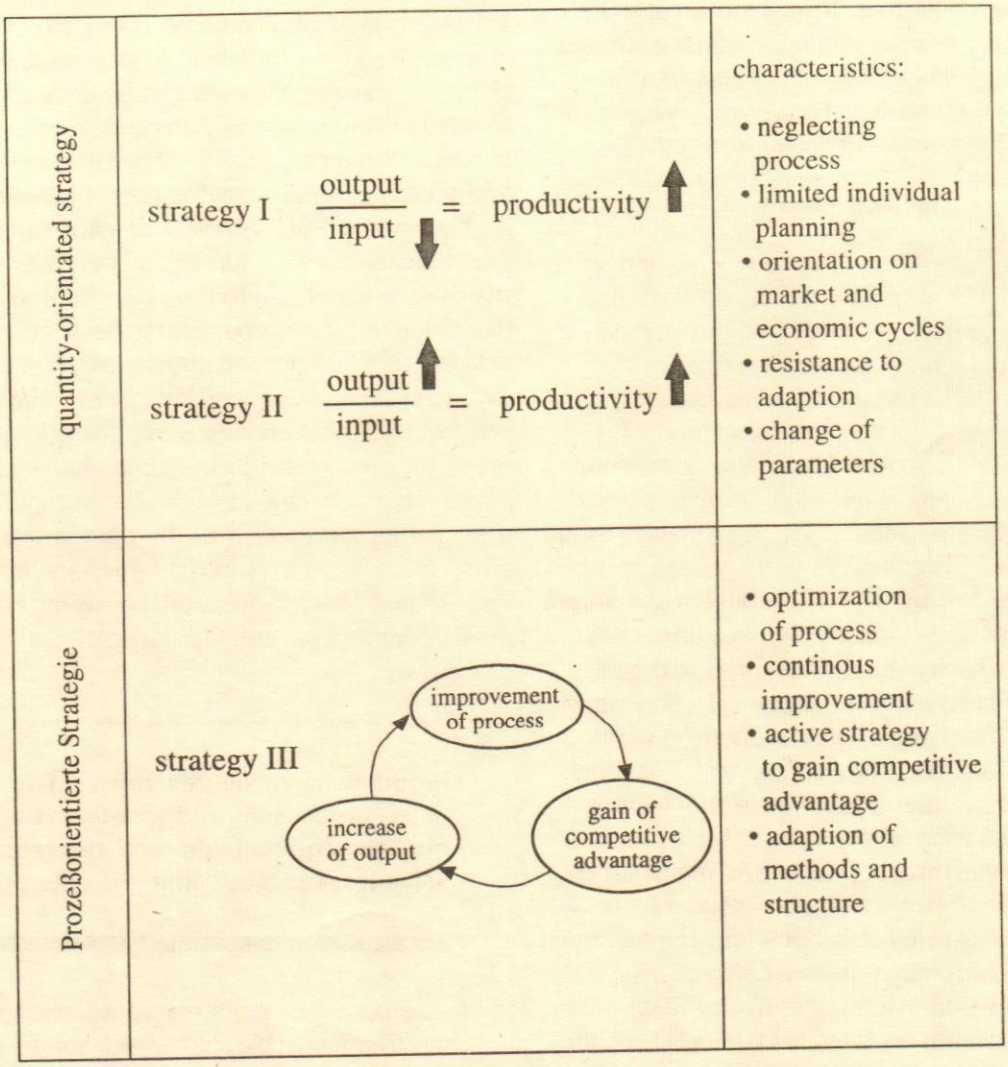

Fig. 1. Basic strategies to increase productivity

Defining increase in productivity as the attempt at continuously improving the relation between input and output, irrespective of current market cycles by optimizing processes assigns prime importance to the transforma-

past-data instead of fixing them anticipating market needs. Besides, no precise measurements are related to these productivity targets. Different measurements have to be chosen at lower hierarchical levels. Furthermore

there is the danger of short-term maximization instead of long-term maximization of productivity. The same statements can be made for strategy II. Often the process is not improved in the long run. On the contrary, a short-term maximum of output is reached which may have negative effects on a medium range. A short-term increase of the output by higher work intensity in the manufacturing sector leads to an increase in machine down time and to a shorter durability of machines in the medium run. Therefore besides working more, more intelligent working structures are required for a permanent raise in productivity. When decisions to implement strategy I or II are taken, intraorganizational criterions and competitive criterions have to be taken into consideration. Empirical analysis concerning strategic planning such as the PIMS study prove that an aggressive market strategy aiming at a high market share can be viewed as a prerequisite for corporate success. However, this requires the realization of competitive advantages which cannot be achieved by a mere quantitative strategy.

Strategy III on the other hand, awakens the optimism and motivation of the organisation by defining future orientated process targets. According to the changes in the evaluation of objectives and the integration of new partial objectives, the focus on produced quality as an output figure (which built the basis for mass production in seller's market) is abandoned. Productivity measures referring to business processes and relating them to market requirements are necessary to solve weaknesses within the enterprise. Productivity in this sense can be regarded as an effective and efficient fulfillment of market requiring within process chains (Wildemann, 1993). These requirements have to be defined for each organizational unit and quantified within the scope of a cooperative target agreement. The conclusion that anything which is not measured will not be improved, is valid. Although many companies have recognized these problems, the reporting and controlling systems are still orientated towards the traditional measurements. As management in the manufacturing sector is further measured by traditional productivity measures, it is not surprising that the changed objectives are not pursued consequently and permanently in the enterprise (King & Wood, 1989). The concept of visualization has proven its benefits for the implementation of changed performance and process objectives within the organisation. Hereby, transparency regarding targets and their fulfillment is established. The concept is implemented by the installation of visualization boards at every corporate unit and at every hierarchical level. Information such as the description of assignments, capacity coefficients or staff data as well as targets and their fulfillment, current projects, measures and problems are shown on charts. The members of the unit themselves have to take care of the boards. They control the achievement of their objectives. The aim is to solve problems at their place of origin by employees of the particular corporate unit, which raises performance figures. Making responsibilities obvious and information about process improvements available will result in an increase of the staff's motivation and problem solving capacity. By describing the correlations of individual measurements and the achievement of objectives the aspired learning process of the organisation is supported effectively (Boucher, 1987). Information down time is avoided and shorter control cycles are realised. The gathering and presentation of data and information is done in a standardized way and according to the applied methods. Thus, a simple comparison between organizational units can be reached. The staff is trained in the use and presentation of simplified ways to show results such as histograms, ABC-Analysis or cause-effect-diagrams. The management is forced to necessary information themselves according to the pull system at the origin of the problem. Thus, the borders between departments and functions are bridged and there is a greater emphasis on each value-adding working place. Data and information from the cost centres within the production department are aggregated to departmental informations and presented at a central location, for example in the breakroom. The aggregation of the data is made across all levels of the enterprise including top management. The visualization concept offers the possibility of integrating a great number of employees into the improvement process.

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In the past, European enterprises preferred productivity improvement in big steps which should ensure major breakthroughs, for example by implementation of CIM modules. Only specialists and selected top managers were included in the improvement process. The benefits of this innovation in major steps have mostly been limited timewise, because supporting measures to stabilize standards in everyday business have been neglected. While the improvement in big steps takes place only

during defined period of time and productivity advantages can be imitated and compensated by competitors, the continuous improvement is characterized by a steady process which the competitors can copy only with major difficulties because of its variety and individuality, thus leading to lasting competitive advantages (Imai, 1992). This production concept does not assume a compulsory mechanism between input and output but includes "the process" as a major factor for success. The striving for process harmonization of far-east management leads to a concentration on the "gemba", the place where the value adding process actually takes place. Each decision-maker visits this place regularly. This leads to higher motivation and identification. The process orientation requires that corporate processes are clearly defined and reported as standards. Therefore the organizational structure has to be arranged in a way that leads to repetitive processes.

Productivity Increase in Material Flow Process

The analysis of the term "productivity in the flow of material" starts with the market and customer requirements concerning the flow-of-material. These requirements consist of the consignment of the agreed products in the right quantities and types at the right time. The term "customer" applies not only to the final buyer but also to the internal customers. The input factors for the flow of material process are material stock, transport and storage area, transport capacity in the form of means of transport and personnel, material planning capacity for steering the flow of material as well as container and packing material Transparency, utilization rate, flow rate, standardization rate and complexity rate are relevant as process factors in the flow-of-material. The performance figures for the output of the flow of material process is the delivery service rate, it is defined as the ratio between deliveries matching demand and the total number of orders (Busch, 1989). The performance figures ensure that the activities in the flow of material are consequently aimed at customer requirements. Increase in productivity is measured by the success factor time in contrast to simple quantities. Increase of process productivity in the flow of material is achieved by maximizing the delivery service rate proportionately with the input factors. In this context one has to take into account that the delivery service rate cannot be varied arbitrarily by the enterprise. It has to satisfy the market's minimum demands. Considerations for a maximization of the productivity shall be based on the relations shown in figure 2 which gives the ratio between the input and the delivery service rate as a function. With an increase in the application of input such as inventories, space, transport and coordination capacity, the delivery service rate increases. At first, the delivery service rate grows progressively beginning at zero-point, until it changes at point A into a digressive trend. The average ratio between delivery service rate to applied input has its maximum in point B. If the delivery service rate is not predetermined at another level by the market, the productivity target for the flow of material process could be found here. Normally however, the delivery service rate is given by the market. Therefore, the objective is not a maximization of productivity but the optimization of it by fulfilling the market requirements with an economical use of resources. It is important that the enterprises have to meet the different requirements according to industry, market situation, and product mix, regarding the delivery service rate. Just-in-time procurement patterns, for example, require a delivery service rate far higher than the procurement of standardized parts. Therefore, the productivity target must be defined according to individual requirements with an adjusted and corresponding flow of materials. Figure 2 shows that the delivery service rate starts to decrease at a particular critical input quantity. The increase of stock level within the production no longer leads to an improvement, but causes extended throughput times and a loss of short-run service flexibility. Moreover, increased complexity and with it the susceptibility to errors of the material flow system exceeds a defined level use. Additional transports or the use of more containers represent waste along the process chain. A psychological effect is added. On the one hand a high input level results in a feeling of security within the organization of the company which reduces awareness of problems; on the other hand it covers basic errors in the

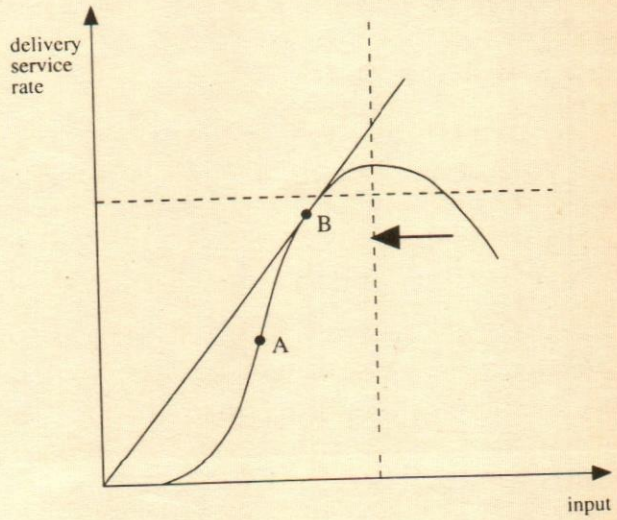

Fig. 2. Delivery service rate as a function of input

flow of material. Both the lack of problem consciousness and the difficulty in identifying waste make the actual problem-solving difficult.

The objective is not a maximization of productivity but the optimization of it by fulfilling the market requirements with an economical use of resources.

The main tasks of productivity management, concerning the flow of material, are the identification and realisation of the most economical material flow concept. Many companies are in the falling area of material flow function (and they are not aware of it). If markets ask for an increased service level, companies often react incorrectly by increasing the input level. This means an increased stock level, extended storage facilities, more transports and more coordination activity, which raises cost and deteriorates efficiency in the flow of material. For most companies, the effective way to improve material flow productivity is to reduce the inputs level. By doing so, an improved input-output-relation is achieved on the input side and secondly an improvement of the output is realized. This leads to a lower stock level, smaller storage facilities, reduction in transport, containers controlling activities.

Figure 3 shows the connection between input level and improvement activities which had been determined through practice. Above a defined input level, there are no more improvement activities. Starting from a high level, the input has to be drastically reduced to start the improvement process. Starting from an extremely diminished input level, a small reduction of input results in a progressive increase of improvement activities. Deficits like complicated layouts, redundant handling activities, process difficulties (such as plants which are susceptible to breakdowns), quality problems or lack of qualified workers become obvious and get corrected to achieve the desired service level. A small reduction of the input leads to a problem solving spiral according to the principles of continuous improvement (Fig. 4).

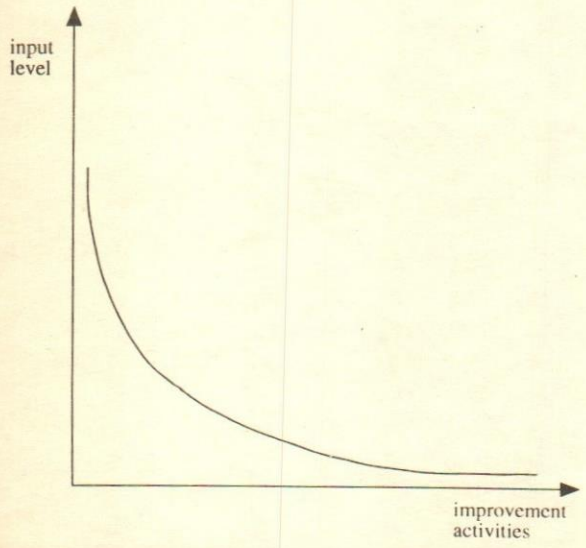

Fig. 3. Relationship between input level and improvement activities

A small reduction of input results in a progressive increase of improvement activities.

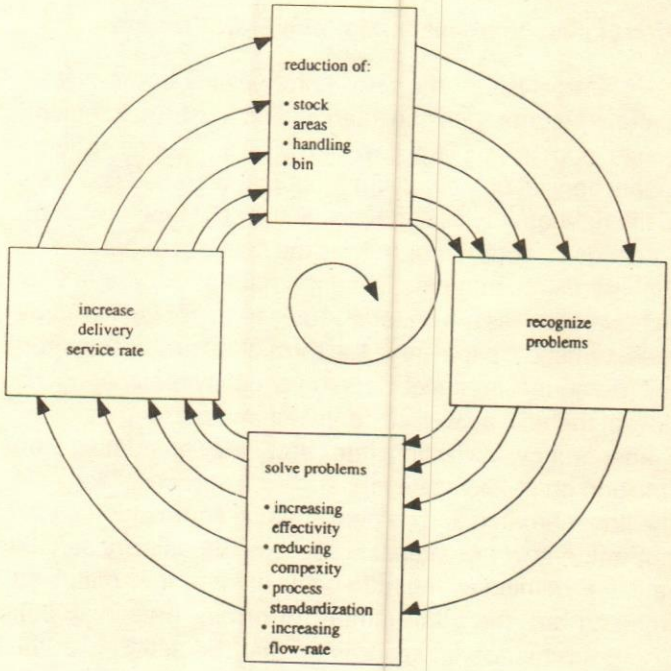

Fig. 4. Improvement spiral

Indicators of improvement activities in the flow of material are the processed data like capacity utilization, the flow rate and the degree of standardisation of the processes. The flow rate shows the relation between the shortest possible throughput time, which consists of operation times and transfer times, and the realized throughput time which contains waiting times. A low flow rate causes problems and leads to higher stocks in the flow of material. Concerning the flow of material, the capacity utilization has to be investigated with regard to

the aspect of missing parts. The degree of standardisation represents an indicator for order and discipline within the flow of material. Discipline in the flow of material cannot be judged without approved standards concerning the application of methods, the realization of single processes and cooperation (team work). These standards include defined areas for the storage of material. These areas are marked for each part and limited to a particular stock level. A standard of cooperation within production is the "Kanban" control systems. Such control-systems are based on rules like clear cut definitions on transport activities, or the production of standardized batchsizes which have to be obeyed. Standards reduce variability in the flow of material. A corresponding lead time scheduling in manufacturing is based on reliable data, which results in a reduction of variability of throughput times and leads to an increase of the service level. Visualized standards enable easy communication of knowledge within the organization. This leads to a common understanding of situations and problems. By introducing Kanban-control systems, the controlling power is given to large number of workers in the production area. In this case standards build a base for the process of organizational learning. The problem solving capacity of a larger number of workers can be used to improve processes.

Productivity in Administrative Business

In contrast to production the term "productivity" in administrative processes is not clearly determined. In order to find a definition, output and input have to be analysed exactly. The task of administrative business processes prepare and support the value adding processes. The following basic processes and dimensions of output can be distinguished:

- Preparation for the value adding process by ordering material, recruiting personnel or planning investments
- Planning, securing, coordinating and controlling business processes by production control, maintenance, controlling, management
- Communicating with markets via marketing, external accounting and research & development aiming at the identification of customers requests and the definition of strategies.

Similar to increase in the division of labour within production, central units have been built in the administration of companies. Earlier tasks had been divided into specialized functions, executed as separate jobs (Holst, 1991). The arising necessity to coordinate divisions and jobs results in the hierarchical structure of the organisation. The distribution of tasks, competence and responsibility is often not synchronized within this kind of organization. Management and controlling concepts have been built according to this organization principle. Goals for the basic processes have not been defined, instead specific goals have been set for specific functions. The isolated perusal of partial aims does not lead to an optimization of the whole performance. Difficulties in communication and a high number of interfaces result in lack of flexibility and longer response time. The companies aiming to achieve competitive advantages, therefore have to be connected directly to administrative business processes. It becomes more and more obvious that a functional organisation structure with a high degree of division of labour does not fulfil the intended goals. Moreover complete process chains have to be designed and optimized. "Business processes can be defined as a sequence of activities which are determined, to achieve a fixed result and can be carried out in a repetitive sequence" (Harendza, Charton-Brockmann, 1992).

The business processes management has to define company processes on the basis of the critical factors markets success such as quality, delivery time and costs. In this sense productivity of administration stands for the achievement of competitive advantages through better processes.

Sommerlatte & Wedekind (1989) defines the following business processes as crucial:

- Customer profit-optimization
- Market communication
- Product/performance staging
- Logistics and service
- Order processing
- Profitability and liquidity securing
- Capacity securing
- Strategy planning and realization
- Staff education and motivation

These different business processes have to be individually specified for each company. For the tasks of productivity management, the amount of output of the different processes has to be specified and described as quantitative index according to the flow of material. Input factors of administrative business processes are information, the process time and the invested capital for equipment for office communication, CAD-jets or data bases. The best way for a continuous improvement of productivity in business processes is to reduce the process time

and the amount of information according to the reduction of stock level in the flow of material.

Time reduction of administrative business processes requires a value analysis of process elements. The focus of the value analysis in contrast to the traditional overhead value analysis has to be directed towards the competitive factors of the different business processes. For the value analysis the following question must be answered: which operations can be reduced, which operations can be restricted and which more efficient methods for the execution of the processes can be applied. At the beginning of the value analysis one has to find out which processes or which process chain represent the critical path for efficiency, because the optimization of non-critical business processes does not reduce total processing time. The well-known methods, CPM or PERT of the network planning can be used to analyse processes (Thumb, 1975). After defining the process structure and determining the critical path, the value analysis starts. Buffer times which often consist of waiting times within administrative business processes, represent a key point for time reduction. The buffer which limits processes has to be investigated with regard to its task and its contribution to the improvement of competitive factors. Especially control-and-decision-processes offer starting points for the elimination of operations. Ordering and investment processes often consist of a high number of non-value-adding jobs such as signing a sheet or getting informed. In the sense of value analysis these operations are often not relevant to improving competitive factors and therefore unnecessary. Besides the examination of the necessary operations along the critical processes path, and efficiency analysis of the execution of operations offers further opportunities to reduce time. In this case the application of methods and resources have to be examined.

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Existing resources within the processes structure have to be allocated according to the criticality or operations. Competence and technical support are to be concentrated there. In practice it was shown that the foundation of competence centers and the integration of critical operations within centers can improve productivity dramatically (Wildemann, 1992). The position of competence centers within the organization and the comprehensive technical and methodical support lead to an increase in motivation and productivity of the concerned personnel. Moreover, process controlling is facilitated by focussing on critical operations. By elimination and optimization of single operations, the time reduced within administrative business processes leads to a reduction of input level and thus to an increase in productivity. Building competence centers does not mean re-centralizing the organisation. The discipline responsibility of competence center personnel remains in the process chain. Besides a value analysis view of separate operations within a fixed process, a further area to increase productivity and to reduce time is optimization of the structure and control of the whole process by time reduction through a decrease in information stocks. These stocks extend the throughput time of administrative business processes and cover errors within the definition of tasks, competence and responsibility of the structural and process organisation. The enormous complexity of information flows in practice reflects these errors. A reduction in the information level within the organisation through a temperate restriction of coordination conversations, data bases, company's mail or the terminals for office communication, forces errors to become obvious. Business units are affected by a reduction of the information level in a different way. In units, where the fulfilling of tasks is impaired, a new information of process chains takes place. In business units where the fulfilling of tasks is not affected in a negative way, working and processing of the reduced information is omitted simultaneously whereby increasing productivity potentials. Through an organizational integration of functions, whose organized work as shared up to now, into entire process chains, (i.e. the product orientated connection of distribution, production, logistic and production control into an order-processing chain) a direct connection is established, the need for coordination is reduced and the process productivity is increased.

Productivity in the Process of Quality Assurance

The concept of preventive quality assurance, which usually is discussed from a product and process point of view and the introduction of specific quality methods is examined in its relation to productivity. Quality methods have a great impact on productivity. Preventing defects during the process of research and development reduces future efforts, which would just add cost instead of increasing value. Detecting defects early helps to avoid

excessive costs and leads to an efficient use of resources. Production is improved; rework, kitting and production control can be reduced and in administrative departments, paperwork, such as repetitive purchasing orders, internal order processing or controlling activities, can be avoided. The increase of productivity by maintaining quality standards is based on the consistent use of quality methods, such as quality function deployment, design for assembly, assembly evaluation methods, failure mode and effects analysis and the methods of Taguchi and Shainin. Quality deployment provides close teamwork between R&D, production and marketing in the process of innovation. Customer needs are transformed into a common company language in an overall process of quality planning. The planning process stretches from the definition of products, components and parts to the definition of production and test instructions. Corrections of earlier plans in the pilot lot and in following periods of the product life-cycle can be reduced dramatically. Another important contribution to increasing productivity is the use of FMEA during the process of design and construction. Risks of production and operation are examined systematically in order to detect defects and to take preventive measures before production starts. In practice, FMEA has proved to be a simple and efficient procedure which is carried out by an interdisciplinary team. DFM and DFA are quality ensuring methods which transform production into the process of product and process design. Checklists are used to understand the need for production form the R&D point of view.

Customer needs are transformed into a common company language in an overall process of quality planning.

Due to the increasing dynamic and complexity of business, production is becoming more and more susceptible to process breakdown – not only of machinery but also of logistics and production control. Many firms suffer from missing parts, wrong delivery or absent personnel. Therefore, another opportunity to increase productivity is to establish a breakdown management which refers not only to machine breakdown, but also to all deviations from operating processes, such as logistics or purchasing. In contrast to ensuring quality, which focuses on defects of products in terms of deviation of characteristics and attributes, breakdown management refers to the process itself, which is not necessarily related to product quality but rather to economic success. Its task is to reduce stochastic influences within process chains and to improve the reliability of process results. Corresponding strategies and measures have to be developed in advance. Differing from the usual practice which *responds* with constant renewing of planning in the production control system, the management of breakdown is to *prevent* breakdowns and take efficient means to stabilize the original planning. Traditional production control systems like MRP are based on a deterministic concept which ignores both alteration of results and parameters of the process, such as quality, capacity and circle, transport and waiting time. The system assumes a known and predictable relation between cause and effect of controlling activities. In practice these assumptions are usually not fulfilled, because the structure or business processes change continuously in terms of organization, personnel and equipment and the type of breakdown and their effects vary with the response of the production system, to control activities. The gap between reality and models in the controlling system requires a frequent readjustment or updating of planning. The whole process, starting from loading and scheduling, to dispatching of work has to be re-evaluated. A quick response to breakdowns is not possible due to the centralized structure of most controlling systems. The time required to handle a breakdown and to start production again is often longer than the actual process time itself. But in order to tackle breakdowns efficiently the reaction time has to be less than 20% of the process time. Taking these facts into consideration, the reactive and improvised breakdown management must be substituted by a systematic concept of a breakdown management.

Differing from the usual practice which responds with constant renewing of planning in the production control system, the management of breakdown is to prevent breakdowns.

A comprehensive analysis of breakdown is the basis of breakdown management. Only the detection of potential breakdowns makes it possible to define preventive measures. The starting point of the analysis is an individual examination of systems elements in terms of parameters and liability followed by the analysis of the interaction between these elements. Quality methods like Design of Experiments (Taguchi and Shaini) enable us to

determine the critical parameters causing breakdowns. For each of these factors, particular strategies have to be defined. For instance, it must be decided whether the cause of the breakdown or its effect has to be prevented. European production strategies tend to buffer the effects of breakdowns. Safety stocks of material and added time are typical for this strategy. In contrast, Japanese strategies focus much more on the cause of breakdowns. Eliminating these causes results in a lasting improvement of the production system and increased productivity by abolishing repeated activities and double work. A suitable approach to start the analysis is a flowchart of material. All breakdowns accruing in the various processes affect the flow of material either by downtime or by inducing a change of original planning. All relevant data like the causes of a breakdown, its effects, the time, its location and the subsequent reaction has to be gathered. Data referring to orders is collected continuously by creating a data system. Data not connected with orders, like machine or tool breakdowns or missing parts, is reported as they occur. Other breakdown data is gathered by statistical process control, which requires repetitive processes. All data referring to breakdowns has to be put together by a clearing authority within the organization. A major problem in many firms stems from the diversity of departments which analyse breakdowns in isolation and only from their own point of view. Breakdowns very often consist of long chain of individual elements. A missing part in cost center A due to delayed delivery by a supplier might cause a downtime in cost center, B, which in turn may cause a machine breakdown when restarting the machinery. From the maintenance point of view, corresponding measures have to be taken. Logistics report analyses the problem of a missing part. The purchasing department is the only authority which knows the final cause. A lot of work can be avoided and productivity increased by putting the data together and by deciding on which element of the breakdown chain, attention should be focused. Breakdown management, has to be understood as a cross-functional task which optimizes activities in order to eliminate process deviations. Besides developing a preventive strategy, breakdown management has to optimize activities which cannot or should not be economically prevented. Empirical evidence proves that up to 40 per cent of all down times are caused by missing maintenance staff. Different structure of organisation like the working groups on the shop floor, which includes maintenance and logistics, can reduce waiting time efficiently. Similar to a route sheet, there have to be standardized plans describing the action to be taken in the event of critical breakdowns. For each type of breakdown, these plans have to be developed in advance. Thus less time to coordinate steps will be needed, which in turn influences productivity positively. Standardizing breakdown activities comes from sharing individual knowledge in the organization. An asymmetric distribution of information can be prevented by a standardized process documentation which includes a definition of responsibilities. Standardized plans create the basis for further process improvement. A fundamental pre-requisite being strict control of standards, different performance indexes have to be defined.

Empirical evidence proves that up to 40 per cent of all down times are caused by missing maintenance staff.

To sum up these arguments, three points have to be stressed. Productivity as a ratio of input and output is not automatically related to changing company goals. Due to the fact that modern markets require different performances in products and in services, productivity means more than simply maximizing the quotient of input and output in terms of mass production. Various performance indicators have to be integrated into a productivity analysis. Secondly understanding productivity should shift focusing on the results of individual functions to focusing on different cross-functional business processes closely connected with market needs. In particular, processes in administrative departments should be integrated more closely. Finally, it is important to understand that there are different starting points to increase productivity. Reducing stocks or improving quality is the same mechanism which leads to improved productivity. The basic strategy is to eliminate all forms of waste by unbuffering the company.

References

Boucher, T.O.: Some implications of learning theory for assembly line design and labour productivity, Engineering Costs and Production Economies, January 1987.

Busch, U.: Produktivitätsanalyse, Erich Schmidt Verlag, 2. Aufl., Berlin 1989

Cameron, K.S.: Effectiveness as Paradox: Consensus and Conflict in Conception of Organizational Effectiveness, in: Management Science, May 1986, p. 539-553.

Hahn, D./Laßmann, G.: Produktionswirtschaft, Bd. 1, Physica-Verlag, Heidelberg/Wien 1986

Harendza, H.B./Charton-Brockmann, J.: Geschäftprozesse planen und optimieren, in ZwF, 10/1992, p. 564-568

Hayes, R.H./Clark, K.B.: Warum manche Fabriken produktiver sind als andere, in: Harvard manager, 4/1981, p. 58-69.

Heinen, E.: Industriebetriebslehre, 7. Aufl. Gabler Verlag, Wiebaden 1983.

Heinen, E.: Grundtatbestände betrieblicher Entwicklungen, in: Jocob, H. (Hrsg.): Industriebetrieblehre, Gabler, Verlag, 3. Aufl., Wiesbaden 1986, p. 323-378.

Holst, J.: Prozeß-Management im Verwaltungsbereich der IBM Deutschland GmbH, in: IFUA Horvarth & Portner GmbH (Hrsg.): Prozeßkostenmanagement, München 1991.

Imai, M: KAIZEN-Der Schlüssel zum Weg der Japaner, München 1992.

King, R.A./Wood, G.C.: Productivity: Overcome cultural barriers to manufacturing improvement, The Journal of Business Strategy, 3/1989.

Schaper, M.: Gesamtbetriebliche Produktivität, Verlag industrielle Organisation, Zürich 1984.

Sommerlatte, T./Wedekind, E.: Leistungsprozesse und Organisationsstruktur, in: **Athur D. Little (Hrsg.)**: Management der Hochleistungsorganisation, Gabler Verlag, Wiesbaden 1989.

Thumb, N.: Grundlagen und Praxis der Netzplantechnik, Müchen, 3. Aufl., 1975.

Wildemann, H.: Die modulare Fabrik: Kundennahe Produktion durch Fertigungssegmentierung, 3, neubearbeitete Auflage, St., Gallen 1992.

Wildemann, H.: Fertigungsstrategien-Reorganisationskonzepte für eine schlanke Produktion und Zulieferung, Müchen 1993.

Wilden, P.: Entwicklungsstand des Produktivitätsmanagements, in: Kostenrechnungspraxis, 2/1989, S. 60-67. □

Agenda for Adaptive Change

The agenda for adaptive change may mean a rethinking and fresh scrutiny of such varied aspects as: specialisation of all tasks; the time prescribed routine of work; the intensification of competition; the obsolescence of the older craftmanship; political controls, the contents of higher standard of living; disintergration of the neighbourhood; the breaking up of the old family system; monolithic giant corporations in the pursuit of new wealth and power; the increasing dominance of urban ways over those of the country; the challenge of industrial organised groups, particularly the organisations of labour; the forms of authority particularly the power organised on a plan of subordination of man to man; and, above all, the potential of man.

– An Adaptation
From Alvin Toffler's The Third Wave

Global Status of JIT – Implications for Developing Countries

Harish Padukone & S. Subba Rao

The Japanese have been in the forefront of the new time-based competition with their new paradigm of manufacturing based on just-in-time (JIT) concepts. In its essence, JIT represents a whole new philosophy of organizing work with the ultimate aim of increasing productivity and flexibility through the elimination of waste and the consequent improvement in quality. Since time compression translates into faster asset turnover, increased output, and flexibility and speed of response to customers, JIT has the potential to achieve many of these benefits. This paper evaluates the emerging trends in JIT practices.

Harish Padukone is from CIMNET Systems Inc., Westmont, Illinois and S. Subha Rao is Professor, ISOM Department, The University of Toledo, Toledo, Ohio 43606.

JIT can be viewed as a methodology that provides for the cost-effective production and delivery of only the necessary quality parts, in the right quantity, at the right time and place, using a minimum of resources. This is achieved through various techniques, success of which is critically dependent upon total employee involvement and cooperation. Within a company, JIT seeks to achieve as continuous a flow of production as possible from the receipt of raw materials to shipment of finished goods. Some of the elements of this system are: streamlined flow/layout, set-up time and WIP reduction, simplification and standardization of products and processes, preventive maintenance, high quality, organization of work in cells, flexible workforce to match production rate as far as possible to demand through mixed mode production. All approaches cover four fundamental areas:

Organizing for Change: Creating an environment for change is the essential first step. In Japan, JIT was an outcome of the resource-scarce, space-constrained, yet heavily competitive business environment. This resulted in reducing waste through improvements in quality, and an emphasis on continuous improvement using the cultural advantage of group orientation and high basic education levels in Japan.

Manufacturing Techniques: The core techniques focus on achieving flow through the operations using cellular manufacturing and group technology, supported by set-up time reduction to achieve small batch sizes. This is followed by the use of pull scheduling with either a one-card or two-card *kanban* to replace the traditional push system which is liable to end up in Work In Process (WIP) buildup if production down the line goes askew for any reason. A host of other non-core supporting techniques include the use of smallest possible machines arranged in a U-shaped line within a cell, the principle of putting away anything that is not required (*seiri*), arrang-

ing things for maximum advantage (*seiton*), preventive maintenance, foolproof devices for preventing mistakes (*pokayoke*), etc.

Materials Control: The Western manufacturing planning and control systems, while mutually supportive of JIT, require modification in use. The use of 'flat' bill of materials, simplified to reflect the continuous flow; backflushing, whereby daily materials consumption is more easily derived by calculating output and scrap for the day, are examples of such modifications. The use of OPT and *heijunka* (balancing of production) to smooth production schedules, and undercapacity scheduling and visible production control to enable prompt problem solving and ease of control are other useful techniques used in JIT.

JIT Purchasing: The most readily recognized aspect of JIT is, one that allows timely delivery of small quantities of parts of 100% quality, often to the production area directly. JIT in purchasing can succeed only if the internal production environment has already been successfully modified to a JIT mode. Purchasing in this mode requires reducing the number of suppliers of a chosen trustworthy few who can deliver consistently high quality products and make the necessary accommodations like frequent small lot deliveries in standard containers, involvement in product development and design, etc.

Origin of JIT

Though Toyota Motor Company is credited for promoting the use of JIT in Japan and abroad, it was the shipyards in Japan that first employed it to establish firmer control over the delivery of steel plates and fittings. The Toyota concept had (and has) twin objectives – the reduction of cost through elimination of waste, and the fuller utilization of workers' capabilities. The key principles of the Toyota system are JIT production to reduce overall lead time using the two card kanban to pull parts through the system in tune with demand; the ideal of one-piece production aimed at cutting down lot sizes; levelling of production through use of mixed model assembly lines, depending on a range of cycle times to produce smooth schedules, and a flexible work force. Full use of workers' capabilities was achieved through elimination of waste movements and empowerment of workers on the line to influence their work environment. These principles were quickly picked up by other Japanese firms who added refinements of their own, starting with Toyota's own suppliers. For example, Fujitsu has adapted it to a hi-tech environment and Maxcell to a process environment. Important developments were adoption of JIT to work alongside traditional planning systems like MRP, by Fujitsu, and the new approaches to maintenance within JIT developed to Tokai Rubber, which has led to total productive maintenance.

Waste Elimination

The core philosophy of JIT has expanded to eliminate waste in all its forms as a precursor to improved productivity. The causes of waste have been narrowed to 12 main sources in the manufacturing environment. The waste removal philosophy is summarized by the 3M's: *muda* meaning a state of things in which materials, equipment and manpower add wasteful cost and contribute nothing to add value; *mura* which refers to a lack of consistency in work, intermittency in flow or imbalance in work assignments; *muri*, which refers to unreasonable, excessive or strained performance that often follows *muda* and *mura*.

JIT Practices in Japan Today

While JIT programs vary widely, the core of all of them is three-fold – flow, flexibility and development of the supply chain. All Japanese firms emphasize developing continuous and smooth flow in manufacture, since every time the line stops, it is unproductive. JIT assumes short production runs and focuses on minimizing set-up. Cells are used to the extent possible based on group technology, to eliminate or reduce distances that parts travel. Where it is unavoidable, well designed materials handling combines the very simple (for instance, gravity feed rather than conveyors) and the sophisticated (eg: AGVS). The focus is always on the process – designing and managing it for high quality, closely coupled, small batch and reliable manufacture.

While JIT programs vary widely, the core of all of them is three-fold – flow, flexibility and development of the supply chain.

The flow is supported by flexibility. Though flexible automation is used widely, flexibility is also secured through small batch size, flexible work force and spare physical capacity. Small batches are based on the philosophy of manufacturing today what is needed tomorrow and is mainly achieved through set-up time reduction. The benefits of such batches are minimization of WIP inventory and reduced lead times which provide greater flexibility in manufacturing. Spare capacity is crucial, given the variability in Japanese demands. Japanese

firms almost invariably favour spare capacity over investment in stock, since the former allows them to respond swiftly to customer and market changes by switching manufacture and work force from one set of capacity to another. The high level of cross training aids in the flexible use of the work force.

Development of the supply chain is given a lot of attention by Japanese firms, since subcontracting plays an important role in their manufacturing. Factories are designed to accommodate deliveries to the point of use, and suppliers oblige with frequent deliveries every day. The latter is made possible by robust forward schedules, often using electronic data interchange (EDI) provided by the manufacturer. The essence of JIT as it is practised in Japan today is to manufacture only to demand and to couple the manufacture of sub-assemblies and parts tightly to final assembly. Yet, to practise fixed daily production scheduling which can match the final assembly with the feeding of parts, requires a production forecast and plan, which derives from a clear and detailed vision of the market in the short and medium term. This plan is of strategic importance since it becomes a guideline for investment in future. Productivity increases and may assume a lowering of selling price at increased profit levels requiring managers to achieve significant cost and productivity breakthroughs.

The above core activities are, in turn, supported by a wide range of management tools, techniques and top management commitments. Primary among these are the set of housekeeping principles embracing the four S's: *Seiri* (orderliness), *Seiton* (tidiness), *Seiso* (Clarity) and *Seiketsu* (Cleanliness). The aids to visibility like the Andon boards to signal trouble spots, containers with special inserts for easy ascertainment of quantities and display of daily production on TV screens constitute another set. Problem solving also gets a great deal of attention. The emphasis is on extensive training, immediate and permanent solution of problems by getting to the root causes. Underlying all this, is a constant attention to detail, to simplifying and foolproofing spurred on by an explicit philosophy that anything being done can be improved further.

But JIT does not occur in a vacuum, and Japanese firms go to great lengths to eliminate uncertainty and make all necessary resources available to ensure flow and flexibility. Preventive maintenance, often as part of Total Productive Maintenance (TPM), ensures high reliability and quality control and eliminates a lot of uncertainty, as does the design for manufacture and the wide use of modular design for flow and flexibility. Adequacy of resources is underscored by appropriate plant and equipment, the emphasis on people and their education and training, the provision of high level of technical support and production engineering.

There does not exist a single set pattern of JIT. For instance, *Kanban* is still only used by a relatively few companies in Japan, mostly characterized by low complexity of both process as well as products, while other like Hitachi reject it outright. Similarly, though Quality Circles find wide acceptance, not every firm welcomes them and some regard them as dysfunctional. Single sourcing of components is largely a myth. Most manufacturers aim at least at dual source with specific policies guiding the allocation of product between the two suppliers. Single sourcing is evident only where major investments have to be made by the supplier or where joint development efforts are undertaken. Practices differ also in the extent to which automation is applied and the degree to which buffer stocks need to be reduced.

The responsiveness of workers in implementing JIT lies in their training, individual decision making powers, the presence of a greater number of engineers and most of all, their motivation. Training of workers is a strategic issue for most Japanese firms, and its objectives are to permit a rapid transfer of workers between tasks without loss of efficiency, to provide a broader job perspective to permit placing each task in context, to enable workers to play an active role in problem prevention and solving, and lastly, to speed the movement of pilot lines into regular, fault-free production. Typical training extends for up to 2 years for new engineering recruits while ordinary workers are trained both during induction and as part of the regular routine. Such training enables workers to exercise individual decision making on the spot with regard to their work. This is reinforced by a system designed to allow interventions by workers that meet key criteria.

The responsiveness of workers in implementing JIT lies in their training, individual decision making powers and their motivation.

Japanese firms have more engineers and fewer operators than their Western counterparts. The engineers focus on design and redesign of products and processes for simplicity and on preventing breakdowns. They are unlike the functional specialists found in Western firms and have all round knowledge that enables them to cus-

tomize equipment to their own needs. Apart from training, they also resort to extensive use of slogans and campaigns to communicate current priorities, and also share the benefits of increased productivity to motivate the workers and help increase their identification with the firm.

In the final analysis, the Japanese advantage over the West derives from having a national manufacturing strategy. Though unstated, it is based on two main precepts—that all markets are eventually going to be saturated, and that the customer is always the objective. Firms translate this into an ability to introduce new products rapidly, efficiently and reliably, and manufacturing processes and systems are designed to this end with the focus being how it will contribute to increasing and varied customer demand. For instance, OMRON, a firm manufacturing a range of products sees a conflict between diversification and standardization and has responded by developing a FMS, one which embraces the whole factory. Nippondenso, for instance, progresses through the automation route, starting with what it calls spot or point automation, through line, area and cube or solid automation.

JIT in the West

JIT is supposed to have originated in the US when Henry Ford built his model T factory. His mass production principles included a continuous flow of materials, with a cycle time for production, time for production from pressed steel to final assembly, when all went well, being a remarkable 72 hours. The plants are supposed to have had high levels of quality and preventive maintenance, since they operated without buffer stocks. However, the two vital ingredients lacking in that system compared to the JIT of today were that it had very little flexibility and it failed to tap the brainpower and hands-on experience of the employees. In many respects, Henry Ford's approach still colors Western attitudes towards manufacturing today and affects the acceptability of JIT techniques and their use. Two main barriers in the way of fuller utilization of JIT in the West are a lack of determination and commitment at the top level to the fundamental upheavals that are needed to revamp the existing manufacturing systems and a host of damaging misconceptions and excuses such as MRP is an adequate substitute, JIT requires high volume batch production, daily deliveries by suppliers, etc. But such arguments are no longer valid nor justified. JIT's value is not just in the operational and cost improvements that are effected but in the myriad hidden problems that it exposes, which in a traditional environment, would lie buried till they begin to adversely affect the organization at the most inconvenient of times.

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JIT in the United States

The basic difference between the Japanese and the Americans vis-a-vis manufacturing is one of philosophy. US companies believed and still do—that improving the efficiency of planning is the best way to achieve continuous production flow and control of inventory. Thus, in the US the focus was and has been on MRP and while few manufacturing firms can today be unaware of JIT and its potential benefits, its implementation is mostly by large companies who have the purchasing muscle to oblige their suppliers to change their behaviour. In adopting JIT, US firms have created their own names (for instance, Omark Industries of Oregon calls its ZIPS; Harley Davidson Motorcycle Company has Material-As-Needed, etc.). They have also applied their own concepts to adapt it to the very different cultural and business realities that prevail in the US "Added-Value Manufacture" is a term which many US top managers find acceptable and which is also more accurately descriptive of the objectives of the approach. Single sourcing has largely remained taboo in order to promote competition and innovation, though the number of suppliers have been reduced through quality accreditation schemes. From the labour point of view, no-stock manufacturing has become a useful bargaining chip to negotiate no-strike deals with their employers.

The primary differences between US and Japan vis-a-vis JIT attitudes and practices indicate that Japanese manufacturing strategy is clearer and stresses flexibility, while the Americans focus on cost and quality. Japanese see it more as a source of strengthening their people, while Americans view it more as a set of techniques. While a strong corporate culture and fluid organizational structure were found to be a common necessity in both countries' firms to improve flexibility by reducing lead times, the Japanese have been more successful in promoting flexibility with their suppliers. Supplier issues prove far more intractable for US manufacturers. Daily suppliers in the US are restricted to a handful, mainly due to the greater distances involved (on average 5-10 times

JIT in Europe

In Europe, high labour costs are the driving force for achieving greater productivity gains. Materials departments seem to be main instigators down the JIT road, which may be damaging to the success of JIT in production in the log run. European companies are generally better at analyzing problems than resolving them. Follow through is lacking due to their lack of appreciation for good housekeeping as a precursor for an effective JIT. The differences in work force structures in Europe with its preponderance of operators as compared to Japan, and the sectionalism inherent in Western organization structures and the greater resistance to change in European firms are difficult barriers to overcome in the wider application of JIT. Nearly two-thirds of the firms were at a fairly primitive stage of logistics management – operating in crisis mode, using fragmented technical disciplines. Less than a quarter of them have links with suppliers and customers, and incorporate logistics as a means of gaining competitive advantage. In Germany, where the top management expert has both an understanding of processes and experience in overseeing major changes, the joint line/employer initiative to humanize work serves to aid in the implementation of JIT. Auto manufacturers have taken the lead in Europe, and Volkswagen is quoted as aiming to reduce average production time for all models from 33 days to 15 days. Bendix Electronics has gained significant benefits by focusing on five priority areas, including decrease and elimination of raw materials and finished goods stock, reduction in manufacturing in-process levels, making production flexible, and employees versatile. JIT has been tried with success even in the cosmetics industry, Avon Cosmetics being the example.

Applying JIT as the 'simplify' stage of the "simplify, automate and integrate" philosophy is useful way of marrying advanced technologies and JIT.

JIT Implementation Strategies

Most flow and line manufacture, a surprisingly large proportion of batch manufacture and a limited proportion of ebbing and project work can be adapted to implement JIT. Even in process industries, where a substantial flow already exists, JIT purchasing and set-up time reduction can lead to major benefits. Applying JIT as the 'simplify' stage of the "simplify, automate and integrate" philosophy is a useful way of marrying advanced technologies and JIT. Such simplification can reduce the amount of investment required in automation, change the nature of the automation required (for instance, a focus on small machines), release capital through WIP reduction to pay for automation, and reduce the need for computer integration later.

There are four areas that deserve special attention. First, performance measures need to be revised to accommodate undercapacity scheduling. Shift the focus away from cost minimization to waste elimination and maximization of value added. WIP, Quality, Lead time, Distances travelled and Space utilization are the other priority areas for revising performance measures. Second, companies adopting JIT must make all levels of their organizations flexible from the very beginning. Third, JIT pushes more responsibility down the line to the operators and supervisors, and these will have to be reconciled with. Finally, the question of leaving well alone is forever out, as the philosophy of continuous improvement takes root. The key preparatory steps required are:

- Top management commitment, involvement and leadership
- Assignment of competent people and money to the project
- Massive education and training imparting basic and required knowledge to the people concerned.
- Focus on housekeeping to improve quality consciousness
- On-the-spot investigation accepted and carried out by all.

The best way to start is to focus on a small cell or a unit, and once this has been made to work, to rapidly transfer the skills and experience round the organization. The critical stage is reached when a company reaches a plateau, from which it is difficult to move on without a company-wide JIT program. This is a much more difficult process demanding the full involvement and commitment of all concerned, and not just an enthusiastic few. One area of groundwork frequently overlooked is customer involvement. By sharing JIT plans with them, they can be convinced to order in a manner and at a time that will eliminate demand fluctuations to a large extent.

JIT Techniques to be Used: One of the more important decisions regarding implementation will be to choose from the portfolio of JIT techniques to apply in the chosen area. By grouping these techniques into two stages, it will be easier to obtain an effective handle on what needs to be done and when. In each stage the techniques support

each other. The first stage (Fig. 1) is composed of areas that are necessary for full JIT to work. They focus on four main elements of JIT that can be achieved in the short term. These are simplicity, flow, quality and fast set-up and lay the foundation for moving on to the more difficult techniques like Kanban and JIT purchasing, which are a part of stage two (see Fig. 2). Some of the techniques in the first group are:

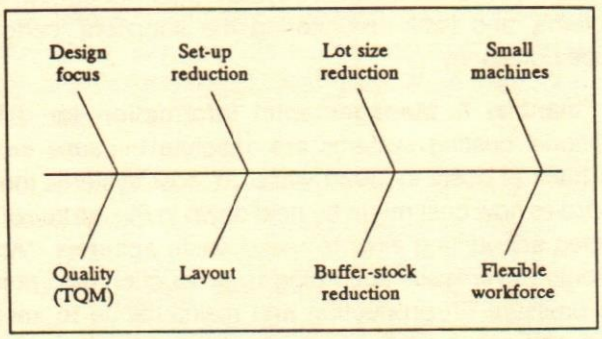

Fig. 1. JIT stage one

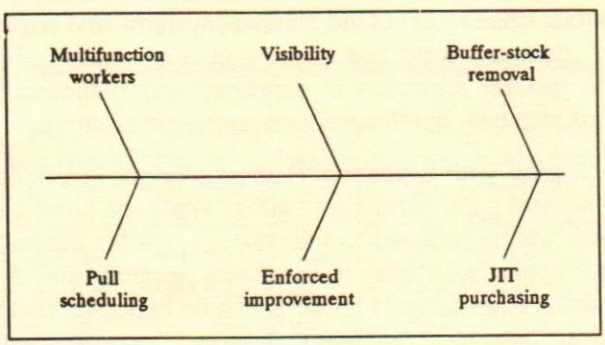

Fig. 2. JIT stage two

Design/Focus: Focus is developed in the factory by designing with the goal of achieving commonality, modularity and options to fit into the production flow. This calls for effective communication and interaction between designers and process.

The Quality Management: This entails the removal of both sources of uncertainty and variability, and of waste. TQM has to be functioning properly in all activities, and not just in parts of the process, because the tolerance for faulty components is so low in JIT. Quality is really a top management issue because without their support, most initiatives will fail.

Set-up Reduction: This assumes significance because the outcome otherwise is both inflexibility and large batches, both of which are unacceptable in a JIT environment. Most set-up take long only because they have not been subjected to a systematic analysis of what happens and what can be done to speed up the process. The answer lies in a focussed attempt to link technology, training and systems to maximum effect.

Layout for Flow: Flow is at the heart of JIT. To achieve this, the first step is the analysis of parts and their movement in order to find patterns of commonality – in terms of manufacturing characteristics, routings and so on. Next, factory layout should be studied with an eye to recognizing cells based on the families of parts. Cells not only provide flexibility, but also greatly reduce the distances travelled by parts. Reviewing materials handling, using small machines in close positions and in U-shape all aid in achieving flow.

Maintenance, Reliability and Spares: Maintenance takes on a whole new meaning in a JIT set-up. Instead of a 'fix it when it breaks' attitude, the emphasis is heavily on prevention. Production and maintenance must now work as a team with one common aim – maintaining the flow of production with a minimum of unplanned down time. They must plan maintenance downtime together, identify and resolve recurrent problems and ensure a common language that is understood by all. Routine fixing becomes the task of the operator, which requires considerable training, in the design and delivery of which maintenance will play an important part. Spares management assumes a critical role in a JIT environment since lack of required spare can stop the entire plant. Measurement and analysis of breakdowns can provide the data to plan for both preventive maintenance and spares stock levels. Maintenance will also feature in equipment purchase and design with an aim of minimizing down time.

The important elements of JIT stage 2 include,

Flexible/Multifunctional work force: The work force is the prime source of flexibility, and they should be prepared to work on a wide range of jobs, and to be moved at short notice. This is achieved by cross-training of workers, accompanied by a review and overhaul of the job grading and payment system.

Full Scheduling: In this system, manufacturing is triggered by a signal from downstream, unlike the traditional push system which sent materials and parts forward whether they are required or not. The rule under JIT is clear: nothing can be made unless there is a signal (Kanban) to authorize it. Kanban is not a technique to start with since it requires stable, repetitive demand or high degree of flexibility/flow.

Visibility: This is a reference to management by sight. Everything and everybody on the plant floor should see

sion as well as in terms of its short term, unpredictive nature.

Organizational Issues

This is the area of direct impact in terms of the spread of JIT. First of all, many of these countries are dominated by small inefficient producers who are protected by their governments. Secondly, a great majority of them tend to be owner-managed, run in traditional informal fashions that have never felt the need to explore avenues for improvements, since profits could always be made more easily by raising prices. Labour is usually uneducated, lacking in motivation and more concerned with monetary benefits and job security than with career progress and development of their potential. The management style is more authoritarian, and crisis oriented aimed at coping with emergencies, than doing things in a planned fashion. Training provided to workers is minimal to non-existent, since there is no premium on quality in the market place, nor is their competition to spur the need for improving products and processes.

Social Issues

Social and cultural issues have a significant impact on the transferability of JIT practices between different parts of the world. Heiko (1989) has laid out the relationships between Japanese culture and many of the techniques of JIT, showing that JIT is basically a response to environmental circumstances. The group orientation, traditions emphasizing hard work and sacrifice for the greater good, the cultural homogeneity all have contributed to success of JIT in Japan. On the other hand, individualism, materialism and the inability to focus on detail in implementation have been the most important barriers in the West. In DCs, the preponderance of cultures steeped in tradition militate against taking control of one's own destiny. This translates into a fatalistic attitude that is not at all conducive to any kind of change.

The group orientation, traditions emphasizing hard work and sacrifice for the greater good, the cultural homogeneity all have contributed to success of JIT in Japan.

JIT in India

India provides an excellent case study to determine if JIT can, should or will be successfully transplanted. A number of companies are implementing JIT is India – TVS Suzuki, Crompton Greaves, Maruti Udyog, Eicher Goodearth Limited, Godrej and Boyce Manufacturing Company, Hero Honda, Mukund Limited, Siemens Limited, Sundaram Clayton, TISCO, Union Carbide and Widia. (D. Chandra & K. Somaiya, 1991). Chandra and Somaiya point to the following in reviewing JIT implementation in India: JIT technology transplantation without understanding the underlying conceptual framework cannot result in long lasting improvements; Japanese training models are not very successful in India; one has to understand that ownership of change is a key factor in the successful implementation of change.

Though India is the tenth largest industrial power, it has been riddled by a protectionist, bureaucratic government that has never allowed its potential to be realized (Economist, 1985). State nationalization of key infrastructure industries and their inefficient operation, coupled with the controls imposed on private business have stunted the growth of its industries. Consequently, Indian goods today are ranked at the bottom in ten dimensions of competitiveness, including industrial efficiency, human resources management, external orientation, product quality, and employee productivity (Das Gupta, 1991). India's foreign exchange reserves and debt position is precarious lending urgency to redressing the above problems. The huge, subsidized state sector, the protected and inefficient private sector both are entailing huge waste of national resources that could be better applied to development. As such, there is an urgent need for considering JIT practices in India.

Though India is the tenth largest industrial power, it has been riddled by a protectionist, bureaucratic government that has never allowed its potential to be realized.

Regarding systemic issues, India has been recently marked by political instability with debilitating consequences for economic policy, leading to high uncertainly. Second, the poor performance of key infrastructure and its control by government means uncertainty for industries as regards key inputs like electricity, steel, fuels etc. Third, the poor transportation and communication infrastructure hinders speed and requires redundancy in systems to accommodate for possible breakdowns, delays etc. Fourth, administrated pricing, export and

other subsidies, cost-plus pricing policies of government buyers all militate against any pressure on producers to reduce costs and become competitive. In terms of institutional arrangements, the government regulates the relationships of firms and labour, suppliers, and financial institutions, etc. This reduces flexibility for individual firms that are required to spend more time in ensuring fulfillment of these regulations and making JIT implementation risky and expensive. Supplies of several raw materials, imported and domestic, are also subject to government control and quotas through various supply agencies which translates into greater uncertainty, and longer lead times. Organizationally, the more developed big industries are in a position to gain from applying JIT. But the unionization of labour and their reluctance to any increase in efforts required by them also hurts the chances for JIT in India. Most workers do not identify with their firms given the individualistic nature of Indians and their low motivational levels. The cultural factors are also biased against rapid massive changes as people prefer an existing inequity to an unknown improvement.

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In the final analysis, though there are pockets of change and high efficiency including companies that are joint ventures with Japanese management, the broader picture is that though JIT could be a godsend for India, it requires a collective will, organization and effort that is likely to be very difficult to obtain. The only prospect for adoption of JIT can come either through a forced opening of market to foreign competition, or a desire on the part of individual firms to develop global orientation and competitiveness. The need, the resources, the human resources are all there; what is lacking is the right attitude, motivation and resolve to succeed.

Though JIT could be a godsend for India it requires a collective will, organization and effort that is likely to be very difficult to obtain.

Conclusion

JIT has revolutionized the world of manufacturing. The Japanese have shown the way for a new positive and humane approach to productivity gains that makes the best use of human resources by focussing on continuous improvement. The West is slowly trying to adapt itself to the best that the new philosophy has to offer, though problems persist. The DCs are the ones likely to benefit the most from implementing JIT, particularly given JIT's compatibility to small business environments and its relatively low investment needs. Yet, serious obstacles hinder the attempts to apply JIT in such countries. An important step towards the transferability of JIT would be to view the philosophy and the underlying motivation of JIT rather than to focus on the particular techniques. Once the goals of continuous improvement, waste reduction and productivity improvement are recognized and adopted, the techniques can always be adapted to best cater to local circumstances. In the end, the most sweeping change that JIT seeks to effect is in the mind, by way of a change in attitude and approach to the way of manufacturing, and indeed, all productive activity conducted in the future.

References

Chan, Seng Jit et al., "An Integrative Model of Japanese Manufacturing Techniques", *International Journal of Production Management,* Vol. 10, #9, 1990.

Chandra, D. & Somaiya, D.K., "Just-In-Time in India", *Production and Inventory Management,* July 1991.

Das Gupta, Surajeet, "Way Below Par", *India Today,* January 31, 1991.

Economist, "Beafing India's Babu", January 12, 1985.

Heiko, Lance, "Some Relationships Between Japanese Culture and Just-In-Time", *Academy of Management Executive,* Vol. 111 #4, 1989.

Negandhi, Anant, "Management in the Third World", *Asia Pacific Journal of Management,* Sept. 1983.

Rhee, Yung Whee & Therese Belot, Export Catalysis in Low-Income Countries, World Bank, Washington, 1990. □

Quality & the Competitive Environment

Ajit Singh

The sweeping changes taking place across the globe have left an indelible mark on the market front. They have ushered in an era of fierce competition at the international level where only quality holds the key for success. The author elucidates the rules of the game in the world economic scenario and concludes that Total Quality Management is the only strategy for emerging victorious on the economic battlefield.

Ajit Singh is Advisor (TQM) in the Associated Chambers of Commerce and Industry of India. (ASSOCHAM), 1 Jai Singh Road, New Delhi 110 001.

The present decade is going to be a landmark decade for India. The sweeping policy changes and economic liberalisation pursued from 1991 by the Indian Government have transformed the business environment. The increased presence of multinationals, access to emerging technology and trends in consumerism are presenting new opportunities, threats and challenges. The wars are now being fought in the market place and not in the battle field. We are now heading towards a global economy where trade and business are conducted in the most competitive manner and not on bilateral terms. Quality has become a competitive necessity in this global market. The customers are putting up suppliers as partners who will meet the same quality standards they set for themselves.

Quality therefore is no more an option but an urgent need for survival and growth in the competitive environment. This focus on quality and customer has taken quality from the shopfloor to the board room. Quality has become a corporate strategy where it is the driving force for the whole business and the entire gamut of an organisation's activities. The focus has rightly shifted from mechanisms and methods of controlling quality at the operational level to strategic quality management. Our culture and our attitudes have a major effect on quality, productivity, workplace improvement and the style of management. These are changing but our future certainly demands that we must not only change them but change them very fast. In this respect, Shores (1990) laments about the American society as follows:

Quality is no more an option but an urgent need for survival and growth in the competitive environment.

"When our culture is carried into the workplace, it becomes our business culture unless the business takes some overt action to change it. Selfish motivation, waste and apathy towards quality combine to detract from the potential productivity of American business. Some businesses can establish strong cultures oriented towards quality and productivity. Establishing strong quality and productivity culture, however, would be easier if it were already ingrained in our society as it is in Japan." Competitiveness has become one of the central preoccupations of governments and industry in every nation, but the success quotient differs. There has been no shortage of explanations for why some nations are competitive and others are not. Yet these explanations are often conflicting and there is no generally accepted theory (Porter, 1990).

Growth of International Competition

In the 1950's there was an explosive growth in international competition. This growth was stimulated by the emerging trend of multinational companies who manufactured and marketed their goods internationally. The resulting intensified competition caused many companies to make quality improvements a part of their business strategy. A new dimension to international competition in quality was added by the post-war Japanese revolution in quality.

Intensified competition caused many companies to make quality improvements a part of their business strategy.

When the Japanese first began to export manufactured goods following World War II, the perception in the United States was that the competition was in cost and price but not in quality. This perception largely persisted during the late 1950's and 60's. However, the situation then began to change. A rapid rise in Japanese salaries reduced the competition in cost and price. In contrast, competition in quality increased as the Japanese evolved a revolutionary rate of quality improvement (Godfrey, 1992).

The competitive advantage derived by a country in the international market is dependent on the domestic competition. Virtually every significant industry in Japan has intense competition as illustrated in table 1.

The competitive advantage derived by a country in the international market is dependent on the domestic competition.

Table 1: Estimated Number of Japanese Rivals in Selected Industries

Air conditioners	13	Motorcycles	4
Audio equipment	25	Musical instruments	4
Automobiles	9	Personal computers	16
Cameras	15	Semiconductors	34
Car Audio	12	Sewing machines	20
Carbon fibers	7	Shipbuilding**	33
Construction equipment*	15	Steel***	5
Copiers	14	Synthetic fibers	8
Facsimile machines	10	Television sets	15
Lift trucks	8	Truck and bus tires	5
Machine tools	112	Trucks	11
Mainframe computers	6	Typewriters	14
Microwave equipment	5	Video cassette recorders	10

Sources: Field interviews: Nippon Kogyo Shinbun, Nippon Kogyo Nenkan, 1987: Yano Research, Market Share Jiten, 1987: researchers' estimates.

* The number of firms varies by product area. The smallest number, ten, produced bulldozers, fifteen firms produce shovel trucks, truck cranes and asphalt paving equipment. There are twenty companies in hydraulic excavators, a product area where Japan is particularly strong.

** Six firms had annual production in excess of 10,000 tons.

*** Number of integrated companies.

In this environment, domestic margins are sometimes lower than those of international markets. In Japanese industry the competition is not always on price, especially in consumer goods where each competitor has his own exclusive distribution system, but rivalry in virtually all dimensions remains fierce. That is why, for Japanese companies, competing with foreign rivals often seems to be a relief. These trends in domestic competition initiated changes in the international scene. The Japanese quality movement spread to the entire world and different nations reacted differently. The 1970's witnessed various strategies adopted to deal with the new competition in quality. A new range of strategies were tested and adopted by various countries which were aimed at blocking foreign import through:

- Legislation, trade barriers and quotas
- Civil law suits
- Criminal prosecution etc.

However, in contrast, many managers realised that the way to tackle competitive challenge was to become more competitive. This marked a new style of management, new focus (internally and externally), and strategies. These strategies included use of statistical process control, participative style of management through quality circles, vigorous inspections and tests, automation, continuous quality improvement etc. The companies which took the lead and based their philosophy central to people started reaping the benefits. There rose a demand for adopting several Japanese management techniques and philosophies. No wonder the process of quality circles became a universal phenomenon. It continues to be implemented even today in more than 25 countries. Several methodologies were tried to ensure frontline empowerment through self control, self inspection and self supervision. Competitiveness became a part of market forces and a way of conducting business. This resulted in the evolution of integrated concepts such as quality assurance, total quality control and total quality management.

Productivity Improvement

There is no trade-off between quality and productivity. Quality contributes to productivity improvement and is a sure way to higher productivity. The principal economic goal at the national level is to provide a high standard of living for the people. The ability to do so depends on productivity. Productivity is the value of output given by a unit of labour or capital. It depends, therefore, on both the quality and features of products and the efficiency with which they are produced. Productivity is the determining factor of a country's standard of living. The productivity of human resources determines their wages and capital productivity determines the return on investment. Only high productivity can support high levels of income and allow people to enjoy more leisure time. It is the high productivity of companies that provides the strength to meet stringent social standards, health, safety and environmental standards.

In the relentless pursuit of productivity existing industries raise product quality, adding desirable features, improving technology and boosting efficiency. They develop the capability to compete in more difficult segments of market where productivity is generally higher. When there is international competition, the level of productivity attainable is influenced by what is taking place in the global scenario. Porter (1991), observed, "Imports, then, as well as exports are integral to productivity growth. A nation's pool of human and other resources is necessarily limited. No nation can be competitive in (and be a net exporter of) everything."

Internationalisation of Business

Competition in many industries has internationlised, both in manufacturing and service industries. Manufacturing has become a global activity in terms of raw materials, technology and other expertise. Improvement in transportation has lowered the costs of exchanging these items. The national policies that promoted purchasing from high-cost domestic suppliers are giving way to foreign competition. Quality has become the yardstick of conducting trade and business. Competition which would apply pressures for improving quality is, therefore, being encouraged. This has resulted in internationalisation of business.

Quality has become the yardstick of conducting trade and business.

Capital also now flows internationally. For this, of course, there has to be credit worthiness and also procedures in line with world class norms. In this age of internationalisation of businesses, companies can get advantage of economies of scale by marketing worldwide. There is increased access to emerging technologies in a global environment. So, the process is beneficial to all participating nations and companies.

Strata (1989) elucidates a new learning curve that companies experience when they enter into new competitive markets. The scope of the learning curve is determined by how long it takes to identify and prioritise the causes of the problem and eliminate those causes. The skill of the people and the level of resources do have an impact, but surprisingly, the time required for each cycle of improvement is largely a function of the complexity or bureaucracy of the organization. Notice that this theory of learning differs from the Boston Consulting Group (BCG) experience curve theory that says learning occurs as a function of cumulative production volume, independent of elapsed time. The quality improvement theory says that learning, properly managed, occurs as a function of time, independent of cumulative volume. How else can we explain the success of the Japanese automobile industry, which learned faster than the US industry with substantially less cumulative volume?

In an international environment quality improvement can be faster than expected. Most people do not remember, says Hiam (1992), Toyota's first entry into the U.S. market – The Toyota Crown, the very first Japanese auto export in 1958. By 1960 it had been withdrawn from the US market – for quality problems. Today, Toyota is number four in US having exhibited stupendous improvement – its costs and quality are way ahead of the new competitors now.

Total Quality Management

Quality is primarily a customer issue. Customers require products and services which not only meet the performance requirements but provide satisfaction in terms of safety, durability, performance and pride of ownership (Singh, 1993). Total quality is an approach to improve the effectiveness and flexibility of an organisation as a whole. This is possible only when each function and each person develops an attitude for quality by preventing and eliminating errors, waste, rework etc. TQM, therefore, has to be driven through the entire range of business activities. Team work, participation and communication are the guiding principles in the process of total quality. TQM creates a cultural change in the organisation with overriding priority for quality and customers.

Team work, participation and communication are the guiding principles in the process of total quality.

Marketing strategies based on attractive advertisements alone cannot survive long. They have to be based on the sound foundation of quality, otherwise they will turn out to be gimmicks. There are numerous definitions and varied interpretations of TQM. TQM amounts to applying the principles of quality management to everything we do. The British Quality Association (BQA) has a rather long definition of TQM: "Total Quality Management (TQM) is a corporate business management philosophy which recognised that customer needs and business goals are inseparable. It is applicable within both industry and commerce. It ensures maximum effectiveness and efficiency within a business and secures commercial leadership by putting in place processes and systems which will promote excellence, prevent errors and ensure that every aspect of the business is aligned to customer needs and the advertisement of business goals without duplication or waste of efforts."

Saylor (1992) had drawn an interesting comparison between traditional management and total quality management. To get a clear understanding he summarizes the comparison table 2.

Table 2: Comparison between Traditional Management and TQM

Traditional Management	Total Quality Management
Looks for quick-fix	Adopts a new management philosophy
Fire-fights	Uses structured, disciplined operating philosophy
Operates the same old way	Advocates breakthrough thinking
Randomly adopts improvement effort	Sets the example through leadership
Focuses on short term	Stresses long-term continuous improvement
Inspects for errors	Prevents errors and emphasizes on quality of design
Decides using opinions	Decides using facts
Throws resources at a task	Uses people as primary means to add value
Is motivated by profits	Focuses on customer satisfaction
Relies on programmes	Is a new way of life.

In the field of TQM, there are a number of well known personalities who have expressed their views and approaches on the subject very widely. The detailed explanation of these approaches is outside the scope of this paper. However, one consistent theme they all share is the stress on customer expectations. This had led to the development of the concept of internal customer.

Role of ISO 9000

No other quality system standard has had so much impact on the world a the ISO 9000 series has. First published in 1987 by the International Organization for Standardisation (ISO), ISO 9000 has now been adopted without any change as a national standard in some 50 countries including all of the EC and EPTA countries, Japan and the USA.

ISO 9000 standards are playing the role of global harmonisation. Several political leaders and their governments have initiated national quality policies recognising that quality is the basic foundation for national economies. Globalisation has become present reality in many areas since the ISO 9000 series was published. Today even the small, commercial and industrial enterprises are finding that their market places include competitors which are multinationals. Consequently, quality improvement and marketing strategy have to be done globally to reckon with global competition.

The growing acceptance of ISO 9000 as a national/international standard is resulting in the rising demand for third party certification. As such, third party assessment and registration services have been organised through National Accreditation System in about 32 countries. Many nationally and internationally recognized products certification systems (for example BSI Kite mark in U.K., JIS mark in Japan) have incorporated the ISO 9000 standard as a first phase requirement for approval to use their marks in specific products certification scheme. ISO 9000 has therefore become a must as a strategy to be internationally competitive. In India there are 102 companies which are already certified as meeting the ISO 9000 requirements. The ISO 9000 standards can be regarded as a foundation for quality management to achieve the broader objective which is total quality improvement (Leong, 1992).

ISO 9000 is a minimum requirement in a market driven economy. Says Ronald HenKoff, "Think of ISO 9000 not as another variant of Total Quality Management but as a set of generally accepted accounting principles for documenting quality procedures". With certificates issued worldwide estimated at more than 30,000, the standard is rapidly becoming an internationally recognised system comprehensible to buyers and sellers (Ronald, 1993). However, as there is emphasis on documented quality systems, it may result in too much of paper work in a company.

ISO 9000 is a minimum requirement in a market driven economy.

Developing Strategies

Companies and not countries compete in the international market. Hence domestic demand conditions reinforce the competitive spirit and have significant influence in the evolution and development of industry. Porter (1990) says, "In most industries, a nation succeeds because it combines some broadly applicable advantages with advantages that are specific to a particular industry or small group of industries. In facsimile, for example, Japan combined a broadly applicable pool of skilled and motivated workers and a generalized advantage in complex automation and mass production with unique demand conditions of facsimile machines and strong positions in a number of vitally and supporting industries. Conversely, the United States has failed repeatedly to capitalize on basic research strength in important generalized technologies because other more industry – specific determinants were not in place".

Domestic demand conditions reinforce the competitive spirit and have significant influence in the evolution and development of industry.

Whatever be the market, domestic or international, the companies have to develop strategies for competition. It is desirable to understand the competitor's capabilities, strategies, areas of vulnerability and the potential threats they present. A company must develop its own strategies for resource allocation and competitive focus. On the business battlefield, competitive intelligence and strategies are a core ingredient in winning (Gordon, 1989). Some of the key decision points for strategies are as follows:

Business Arena

The company may select the right competitive arena on which it may compete to gain market share. It must consider market segment and size, the rate of growth, market outlook, number of competitors already existing, level of technology, profitability and future prospects. After considering these factors, the company may decide upon several action points. Market continuously evolves and therefore the strategies have to be kept flexible to get adjusted to changes in market conditions.

Focus on Quality & Customer

The goal of an organisation should be to make quality a basic business parameter, quality in everything the company does. Customer is the focal point of a business and quality is the attribute and index of his satisfaction. Every employee must understand that customers hold their pay packets. Customer orientation must be driven through the entire company operations by maintaining positive work attitudes and work habits ingrained in an organisational culture. Employee satisfaction and customer satisfaction are independent. Survival and growth in a competitive environment is possible when employees work as a team with cooperation and collaboration.

The goal of an organisation should be to make quality a basic business parameter.

Business War

A company should be ready with strategies to bear the onslaught of market wars and also beat the competition by launching aggressive attacks, rather than be on the defensive. It would be simplistic to suggest that a single rule of strategy would be sufficient. Gordon (1989) says "market share leaders must protect their share and thus should simultaneously follow a defense strategy and themselves attack before their competitors do". The number two company in a market or market segment should be offensive against the leader and seek to gain ownership of territory that is now superior or could prove better in the long run. It should do this by focussing on competitors with a weaker market position rather than by launching an uphill battle against a stronger company. The number three in a market should conduct flanking maneuvers, looking for high market share in a specific market segment, then chip away at the share positions held by the leaders. Smaller companies should seek to provide what the bigger firms cannot or will not provide. They should follow the strategy of a raider, developing an opportunity and being prepared to redeploy if the segment grows sufficiently large or profitable to warrant consideration by majors.

Some of the important strategies are as follows:

- Use information on market size, growth rate, market share, emerging markets, patronage-criteria, customer perceptions etc.
- Avoid a frontal attack on competitors. Attack on their weaker points. It is a well known fact that those companies who tried to attack IBM head-on, went into graveyard.
- Uncontested territory may exist, concentrate on that. Americans thought that there are no profits in small cars. The Japanese automakers concentrated on small cars and the rest is a matter of history.
- If you are watching your competitors, be sure they are watching you. Therefore, operate below radar range to ensure competitors are caught unprepared and thus create a time lag.
- Any competitive strategy must be based on quality, out-performing the competitors.

Market Maturity

Dramatic changes in strategic direction must take place when the markets mature. Specific business and product line strategies should be evolved alongwith details of implementation. Mission and all functional or business unit strategies must be consistently forming the overall corporate strategy. A company may plan for increasing sales volume or maintaining at the present level in a maturing market or building sales internationally. The important reason for considering investment in maturing markets is to seek long term dominance and benefits. In case a company decides to maintain the market share in the maturing markets, then the strategy must include control on expenses and pricing with close monitoring of own market levels and that of competitors. As the markets mature, the differences of companies, products and services decline. This stems from a proliferation of competition, the dissemination of lessons learnt and experiences within an industry.

Conclusion

As we enter the mid nineties and look ahead towards the twenty first century, we are faced with new challenges. The greatest of these challenges is achieving victory in the economic war. In economic wars, unlike military wars, unfortunately the enemy is not always obvious. It may be in the form of competition, technology, government policies etc. To achieve victory in this war, a company must seek to adapt to today's environment with an eye towards tomorrow. Several approaches are available to meet this challenge such as Total improvement, Employee involvement, Process improvement, Quality leadership, Kaizen, Total quality control etc. All these approaches are considered in Total quality management (TQM). TQM is the winning philosophy with the objective of complete customer satisfaction. It is equally useful in large or small businesses, manufacturing or service industries and public or private organizations. All competitive strategies must be based on the sound foundation of quality. Marketing strategies without continuous quality improvement will turn out to be gimmicks. Quality is a competitive weapon and TQM is a corporate strategy to build competitiveness.

TQM is the winning philosophy with the objective of complete customer satisfaction.

References

Godfrey, A. Blanton (1992), Total Quality Management — Status in US, Global Quality Congress Singapore.

Gardon, Ian (1989), Beat the Competition, Basil Blackwell Ltd. Oxford, U.K.

Hiam, Alexander (1992), Closing the Quality Gap, Prentice Hall, New Jersey.

Leong, Liew Mun (1992), ISO 9000 Certification — The Singapore Efforts, Global Quality Congress, Singapore.

Porter, Michael E. (1990), The Competitive Advantage of Nations, The Macmillan Press Ltd., London.

Paul, Auerbach (1990), Competition — The Economics of Industrial Change, Basil Blackwell Ltd. U.K.

Ronald, HenKoff (1993), The Holy Grail of Perfection, Business Today, August 7-21.

Saylor, James H., (1992) TQM Field Manual, McGraw Hill, Inc. USA.

Shores, A. Richard (1990), A TQM Approach to Achieving Manufacturing Excellence, Quality Press, Wisconsin, USA.

Singh, Ajit (1993), World Class Quality, The Associated Chambers of Commerce and Industry of India, New Delhi.

Strata, Ray (1989), Organizational Learning — The key to Management Innovation, Sloan Management Review, USA. □

Good Management

What is possible is only one pole in managing a business, what is desirable in the interest of the enterprise is the other. It is management's specific job to make what is desirable first possible and then actual.

— Peter F. Drucker

A good management is responsible to ensure; a bias for action; close to customer; autonomy, innovation and risk-taking; productivity through people; strong organisation culture; diversification in the areas of already acquired strength; simple, informal and lean structure and decentralisation with conformism to core organisational values.

— Thomas J. Peters
— Robert H. Waterman Jr.

Making TQM Benefits Reach the Bottomline through Personal Change

Kunal Kamran

A survey was conducted to assess the benefits of Total Quality Management Practices in several organisations. The author attempts to explain the theory behind the consistent success of TQM driven companies and comes up with the conclusion that personal change is the integral part of the transformation process.

Kunal Kamran is the President of Total Quality Productivity Services, 1760, Lake St., St. Paul, MN 55113.

Many success stories and perhaps equal amount of failures are heard about organisations attempting to implement TQM practices in their operations. We all hear so much that one doesn't know what to believe and what not to. So, here are some facts. *Industry Week*, a national monthly magazine for manufacturers and industrial organizations, recently completed a survey of 536 organisations on this subject. Approximately one half responded to the survey (table 1). These results are indicative of the value a TQM process brings to positively influence three important outcomes for an organization.

- Customer satisfaction and retention
- Operational improvements in cycle time, inventory reduction and thruput improvements
- Enhancement in employee morale, self-esteem and satisfaction.

Another major study which is just as well documented as the above one, pertains to a large FORTUNE 500 company whose fortunes have not been flying very high lately. This organization has approximately 100 plants/sites all over the United States, Europe, Asia and world-wide. The organization has adopted the TQM principles very well at some locations and marginally at others. At each of these locations, an assessment was made of five success parameters. These included:

- Customer Satisfaction
- Revenue
- Operating Profit
- Market Share
- Employee Morale.

For each of these five parameters for a period of four successive years (1988-1992), a positive correlation was observed when the performance of the TQM driven organizations was compared to the other organizations where TQM principles were adopted only marginally (Fig. 1).

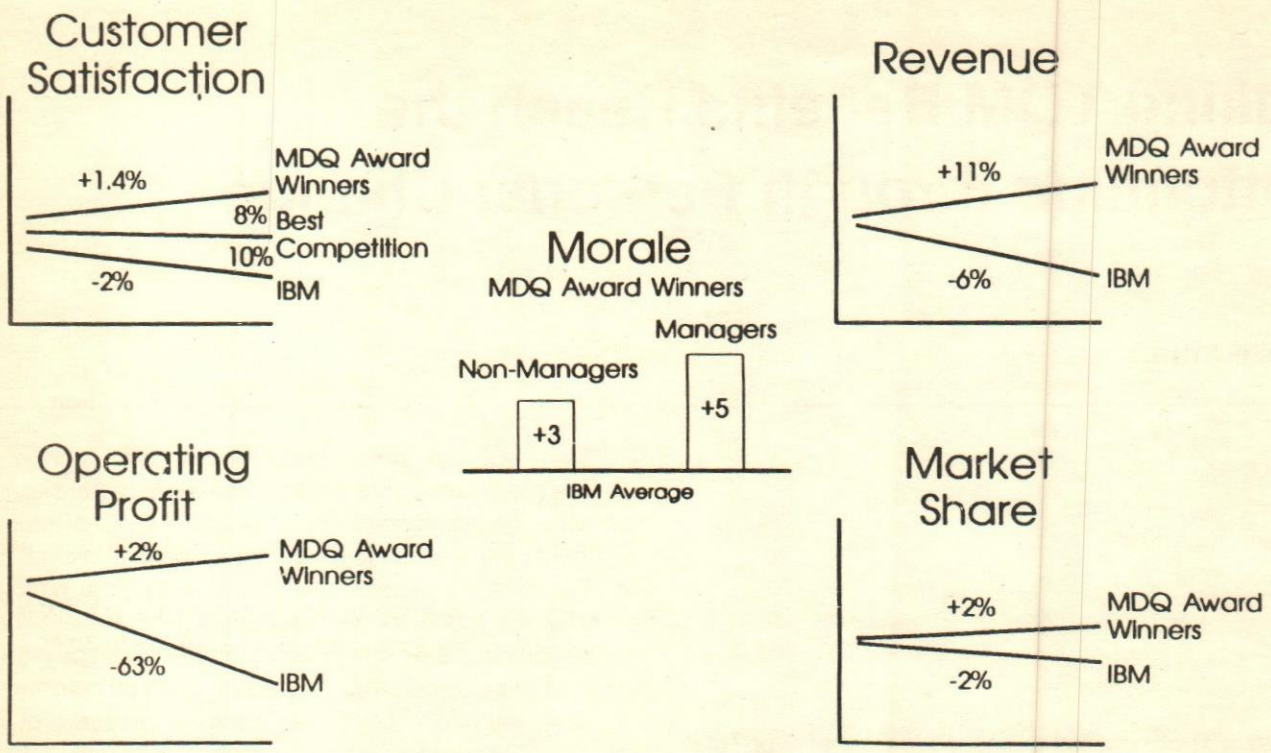

Fig. 1. Quality Pays Dividends

What then is the theory which explains the consistent success of TQM driven organizations and the relatively poor performance at the non-TQM driven sites?

One plausible explanation is the degree of absorption of these ideals in our day to day practices. It is our experience that we all have a great desire to see the results of a successful TQM implementation. Additionally, we go through the training and acquire all the know-how. The reason we don't seem to get the bottom line at some locations is the lack of practice and skill in using these principles to successfully complete the projects. In other words, our efforts are sporadic and have to become habitual enough to influence the results of the organization. Stephen Covey, author of *The 7 Habits of Highly Effective People*, defines a habit as the intersection of knowledge, desire and skill. (Fig. 2).

Stephen Convey defines a habit as the intersection of knowledge, desire and skill.

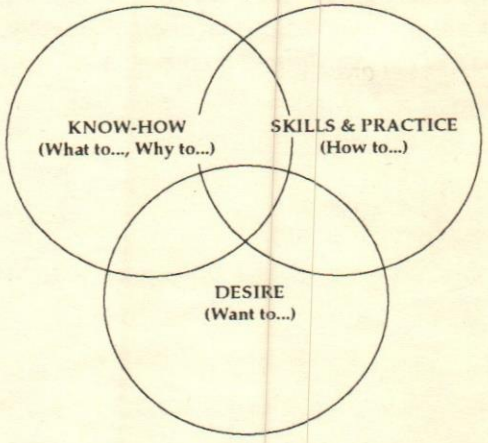

Fig. 2. Elements of Successful TQM Implementation

As with any other habit, we need to be sure that we have a complement of all three elements to make TQM habitual within the organization. As a corollary, this makes clear that having met any two of these important ingredients like desire and know-how, does not bring success because the third key ingredient, skill through practice, doesn't come quickly or easily.

As with any other habit, we need to be sure that we have a complement of all three elements to make TQM habitual within the organization.

In our experience in working with many organizations, we have found that a successful transformation effort requires a change in at least three areas.

Organizational strategic change includes an overall shift in the way we view the purpose and vision of the organization in meeting customer needs.

Systemic Change in the way we do business includes all day-to-day aspects like quotations, order-entry, inventory, scheduling, accounting, machining, assembly, etc.

Personal Change encompasses the way we view ourselves, our paradigms and our relationships with peers and internal customers as we redefine our roles.

A major element lacking in the transformation process of an organization is that while we take a lot of pains in the form of planning and coordination of the first two elements we put very little emphasis on personal change.

The check list given below was developed to address the issue of personal change. Please rank yourself according to the following scale.

3 "Piece of cake. I am doing it all the time."

2 "I am trying and succeeding sometimes."

1 "I am seeing the light at the end of the tunnel."

0 "Good idea. But, I am not prepared to use it yet."

Your maximum score is 99. If you score 100, check your maths. If you score a little less, you know how much improvement you can make. Most of us find many opportunities for improvement. The contention is that we all want to change the entire organization without changing ourselves. The challenge is to accept personal change as an integral part of this transformation process. And, guess who must first change in your organization?

The challenge is to accept personal change as an integral part of this transformation process.

Table 1: TQM-How Successful is it? (%)

Success Rate / Results	Highly Successful	Moderately Successful	Low Level Success	Don't know
Operational				
— Cycle Time Reduced				
— Improve productivity	38	40	15	7
— Fewer Defects				
Customer Satisfaction & Retention	47	38	6	9
Organizational Climate				
— Higher Morale				
— Lower Turnover	44	38	14	4
— Quality Work Life				

Source: Industry Week, April 5, 1993
Based on responses from North American Executives
536 North American Organizations
56% Response Rate

Checklist of Personal Behaviours and Beliefs for a Successful TQM' Organizational Transformation

1. Develop trust in relationships ..... seek elimination of fear
2. Recognize your internal customer
3. Listen to our internal customers
4. Rather than treating them (internal customers) with the subtlest of contempt, always delight them.
5. Teamwork must be a premium
6. All of us must be working in one direction... Customer Satisfaction (Internal & External)
7. Use of data is a must in developing measurements to analyze, resolve problems and continual improvements (PDCA) of processes
8. Interdependency as opposed to independence and dependence
9. Character is ahead of Personality
10. Rather than being arbitrary in the decision-making process, always attempt to listen to opinions and collaborate
11. Think that TQM is not another "fad" and will not pass because it is the way to bring about permanent change in the way we do business
12. Do not wait for other in the organization to start ... especially the boss
13. Work actively on a project team assignment
14. Always ask why we are attempting to change

15. Leadership is required to initiate a new order .... a new culture
16. Premium is placed on education and training
17. Proactive behaviours result from assimilation of values and guiding principles of the company
18. Always think Win/Win in seeking agreements
19. Coaching and mentoring are important expected behaviors
20. Supporting each other
21. Reinforcing successes
22. Modelling the above behaviors
23. Leaders promote and communicate company values and eliminate obstacles that deter them
24. Recognize the informal organization and seek a critical mass of "movers and shakes"
25. Top management be actively involved in leading the charge by planning the transformation, teaching to peers, selecting critical processes for enhancement and seeing them to successful implementation
26. 10,000 successful projects does not constitute a TQM cultural shift... our attitudes, values, closeness to external and internal customers, trusting relationships etc. does along with the successful projects
27. Response – able means working within your own sphere of influence
28. Public victories precede Private victories
29. Success in TQM comes from 5% inspiration and 95% perspiration
30. Employee satisfaction must precede customer satisfaction
31. Intrinsic motivation for success must be distinguished from extrinsic motivation
32. Transformation is replacing the old vertical organization model (hierarchy) with the new horizontal one
33. The sum total of changes in focus, values and methods defines the total transformation. □

Goal of Science

The ultimate goal of science is to create for man the greatest possible amount of pleasure and the least possible amount of pain. But suppose pleasure and pain were so linked together that he who wants to have the greatest possible amount of the one must have the greatest possible amount of the other also? And perhaps, that is how things are.

– Nietzsche

Global Competitiveness: Lessons for Industrial Enterprises

P.N. Rastogi

This paper attempts to answer the basic question. 'How many an industrial enterprise compete effectively in the global market place?' The answer to this question is however, complicated by the fact that the requirements of competitiveness are not static. World industrial scene is changing continuously owing to incessant developments in science and technology on the one hand, and intense competition, on the other. The answer is hence sought in terms of the basic capabilities needed and the requirements to be met, for mastering change. The theme covered in this paper yields lessons in policy and strategy that need to be learned by industrial enterprises.

P.N. Rastogi is a professor in the Indian Institute of Technology, Kanpur.

Globalisation of industry signifies open competition among firms the world over, for providing goods and services to customers in worldwide markets. The basis of competition is the quality and cost of their wares. Globalisation implies free trade in products and services, offering a wide choice to customers across a borderless world. It hence engenders continuous pressure on competing companies to upgrade quality at reduced unit costs, and/or to develop new and superior products in terms of customer needs and preferences. In order to do so effectively, firms engage in relentless pursuit of productivity, efficiency, technology development and innovation, creativity and flexibility.

Globalization is hence also characterized by a free exchange and movement of money, resources, talents, skills, ideas, information, knowledge, and expertise across nations.

As part of their efforts to secure sustainable competitive advantage, firms may source raw material from one country, process it in another, and market it worldwide. They may form strategic alliances and networks with other firms in the same or different countries, to build on each others' strengths, and develop new capabilities for improving or sustaining their respective competitive positions. In their quest for commercial success, firms today are improving, refining, developing, combining, buying, selling, and trading technology around the world at unprecedented levels. Globalization is hence also characterized by a free exchange and movement of money, resources, talents, skills, ideas, information, knowledge, and expertise across nations.

Technological Change & Competition

Intense global industrial competition has engendered volatile dynamics of global technological change. The latter serves to expand and intensify the former. Both of them, in turn, have engendered a number of changes in the nature and structure of world industry. Some of the important observable changes in this context may be listed as follows:

Recent Changes in World Industry

- Shorter product life cycles.
- Shorter product change over cycles.
- Faster rate of new product development.
- Shorter production runs.
- Quality, and productivity-quality integration, in terms of zero-defect production.
- Total quality control (TQC) or company wide total quality system (TQS).
- Equipment and process technology as a strategic resource.
- Flexible manufacturing systems (FMS).
- Increasing importance of project management.
- Technological changes in information handling equipment, and office automation.
- Competitive strategy based on technology, and training of employees in multiple work skills, participation, and responsibility.
- Computer aided design (CAD), and manufacturing (CAM).
- Increasing role of technological forecasting.
- Increasing use of automated decision aids like Decision Support Systems (DSS), Expert Systems (ES), and Simulation Experiments.
- Combination of technologies i.e., 'technology fusion'.

These changes are influencing in a reciprocally reinforcing manner the pace of scientific and technological developments. The latter, in turn, are generating new materials, processes, and capabilities in a spiralling pattern of growth and change. In such a turbulent and volatile milieu, the nature and intensity of global industrial competition, are characterized by both increasing uncertainty and growing complexity, further accentuated by the emergence of unexpected competitors, unsteady currencies, and unanticipated connections among industries.

Competitive Effectiveness

Requirements to be met by a firm for competing effectively in the global market place, may be identified as follows.

Technological prowess and capabilities of a firm, play a paramount role in the competitive context. The first and foremost requirement for a firm is to achieve a world class capability in manufacturing technology. Without such a capability, the firm would not be able to match the international standards of cost and quality in its products/services. The manufacturing capability, however, also needs to keep pace with continuing improvements in existing technology(ies) on the one hand, and development of new technology(ies), on the other. This formidable requirement in turn, calls for a technology management capability of a high order.

Technology management is concerned with planning and coordination of efforts pertaining to incremental innovation in existing technology(ies), development of new and emerging technologies as necessary, combining older technologies ('technology fusion') to create a new powerful 'hybrid' technology, and acquiring, absorbing and using strategically relevant technologies with minimum leg, when they cannot be developed internally. World class manufacturing capability focuses on the *efficiency* dimension of production, while technology management capability focuses on the *effectiveness* dimension. Together, they serve to sustain and improve the firm's competitive technological position.

World class manufacturing capability focuses on the *efficiency* dimension of production, while technology management capability focuses on the *effectiveness* dimension.

In their efforts to develop new technology and/or keep up with emerging technological developments, firms however, face two types of major constraints. The first relates to inadequacy of resources available for investing in in-house R & D. Cash flow problems, high interest rates, and escalating costs of R & D facilities and projects place severe restraints on firms' efforts toward technology development. The second constraint relates to inherent technical and market uncertainties and risks associated with technovation. Firms, therefore, need to be given proper incentives, help, and support by the government.

For this purpose, a supportive national industrial policy based on the close cooperation of government and industry is vital. Government is required to facilitate the globally competitive strivings of domestic companies by fostering cooperation between industry, labour, bureaucracy, and financial and academic institutions. It has a primary responsibility for orienting and coordinating its policies, and actions toward strengthening the technological resources and capabilities of the country and organizations.

Cultivation of capabilities for world class manufacturing and technology management however, requires flexible organization systems and creative human resources. Such organizations simultaneously possess 'loose' and 'tight' properties (Peters & Waterman, 1982). They implement their projects and manufacturing schedules with tight efficiency, and at the same time provide facilitative environment for creativity and innovation. (Rastogi, 1988, 1990, 1991). Such organizations focus on developing and using the creative potential of their human resources towards a continuing quest for productivity and innovation.

World Class Manufacturing (WCM)

Manufacturing in a generic sense consists of the following three fundamental functions:

- Product and Process Design,
- Manufacturing Planning and Control,
- Production Process and Engineering.

In WCM, these functions are performed by the following systems in an integrated manner:

- Total Quality Control/Management (TQC/TQM).
- Just-In-Time (JIT) System of Production and Inventory Management, and
- Computer-Integrated Manufacturing (CIM).

These three systems are used or practised together in a singular pattern or style of manufacturing (Rastogi, 1992c)

TQM is a quality-focused, customer-oriented integrative management method that emphasizes continuing and cumulative gains in quality, productivity, and cost reduction. These gains are achieved through continuous improvement in product design, reduction in operating costs, reduction in operating losses, avoidance of wastage of time, effort, and material in any form, removal of production-line deficiencies, skills upgradation and empowerment of employees towards detecting and correcting errors, among other measures. TQM involves the participation of every department, every section, every activity, and every person, at every level in an enterprise, in the system-wide continuous improvement effort (Rossel, 1990). Its central integrative focus is the concept of Total Customer Satisfaction with quality and performance of the company's product(s) and/or service.[1]

JIT is a method/system for the management of production and inventory. Its basic principle is to eliminate excess or waste in all areas of operations, that do not add value to the final product. It focuses on having the right quantity of inputs, at the right time, in the right place with right quality, and through a synchronization of all activities to produce the right quality product at the lowest cost strictly as needed. Attaining these objectives implies elimination of significant amounts of waste, such as setup time, machine breakdowns due to poor maintenance, rework time, wastages of materials, and inventory storage. In fact, zero inventories, zero defect production, and zero risk of product obsolescence are basic features of the JIT system.

Studies have shown that 75 per cent of the return from JIT comes from people, while only 25 per cent is generated by the technological components. Effective working of both JIT[2] and TQM depend on the development of human resources.

Effective working of both JIT and TQM depend on the development of human resources.

CIM denotes a broad spectrum of automated manufacturing technologies, ranging from individual computer-controlled machine tools, and flexible machining centres (FMC) to completely computer integrated manufacturing facilities. Its coverage includes design (CAD), engineering (CAE), and manufacturing (CAM) activities (Rastogi, 1991). CIM systems can move rapidly and cost effectively into multiple configurations of components and end products in response to market changes in demand, and absorb component design changes. CIM factories can produce rapidly, and on a continuous flow basis, a broad mix of products with variety of features,

1 Schonberger (1987, 1992) views TQM as not only the central element of the world class manufacturing capability, but also as the very base of the corporate strategy of a firm.

2 For a further discussion of JIT, see O'Grady (1988), and Ohno & Mito (1988) among others.

zero defects, and little or no increase in unit costs. Within a factory, materials travel automatically along short paths, and production is fast, continuous, and virtually unmanned.

In its ideal form, CIM is characterized by the following features:

- Unmanned manufacturing done by robots or automated devices
- Compatible hardware and software systems
- Paperless office and integrated business system
- Data and communication systems of universal standards
- Flexibility of operations and low costs of implementation
- Efficient compliance of hardware and software with business objectives of their use.

The current reality however, deviates from the ideal considerably. A gradualistic or 'islands of automation' approach is usually practised by firms striving towards CIM.[3]

Technology Management

The prime concern of technology management is towards an effective integration of all phases of the product creation process. In this context, firms may focus on building internal critical mass of engineering talent in one or a few technological thrust areas. Such a focus would enable them to develop distinctive core technological competence(s) over time that would serve to provide a viable foundation for their product development efforts. Japanese firms extend this approach further. They pursue technological self-sufficiency and for this purpose often proceed toward mastering the relevant subtechnologies also. They approach R & D from the viewpoint of multiple applications, and the creation of technological capabilities from a relatively long term perspective. They have also given rise to a new paradigm of R & D.

The prime concern of technology management is towards an effective integration of all phases of the product creation process.

3 For a further discussion of CIM, see Powers (1987), and Noori (1990) among others.

Two Approaches to R & D

In the traditional approach to R & D, a company invests in, and implements, projects designed to replace an older generation of technology. It seeks to achieve 'break through(s)' toward developing new products and/or processes. In an alternative new approach to R & D, Japanese firms have sought to focus on combining existing technologies into hybrid technology – the 'technology fusion' approach. The new approach blends incremental technical improvements from several previously separate fields of technology to create products that revolutionize markets (Kodama, 1992). Companies need to include both the breakthrough and fusion approaches in their technology strategies.

New hybrid technologies are greater than the sum of their parts. The fusion of electronic and optical technologies, for example, gave birth to "opto-electronics". It allowed a company like Sharp to be a major player in technologies ranging from colour televisions to liquid crystal displays to customized integrated circuits. By fusing electronic, mechanical and materials technologies ('mechatronics'), Fanuc created an affordable numerical controller – and became a market leader.

Flexible Organization Systems

Successful firms in an industry have access to similar technologies, so new developments are usually matched quickly. What provides a competitive edge to an enterprise is the continuous improvement, interaction, and synergy among the varied elements of design, innovation, production engineering, manufacturing processes, applications, distribution, service, and marketing. Each of these and related functions has to be performed well with balanced excellence for competitive success. This can be accomplished only in and through flexible organization systems, and the use of creativity and talent of the organization's human resources.

Flexible organization systems and creative human resources are necessary for managing the tension between stability and change. Mastery of complex designs, and strict control of details in manufacturing demand stability. At the same time, competitive pressures demand unceasing innovations in products, processes, markets, that imply readiness for change.

Simultaneous requirements of 'tight' and 'loose' structural properties can only be met by the shared values, norms, beliefs, and expectations of the organization members. Flexible organization systems derive their viability from the development and use of the creative

potential of their members. They use creativity as a high value competitive resource through which they not only excel in manufacturing, technology development, innovation, new products, and markets, but also convert challenges into opportunities for growth and profit. Creativity of human resources is marshalled towards innovation through well-designed and planned organizational processes. When structures, methods, systems, and procedures are seen to be impeding or ineffective, they are changed. When they work well, they are widely communicated and fostered. Conscious efforts are made to keep the organization non-bureaucratic and flexible capable of responding to crises proactively, or with minimum delay. Information technology in the form of computers, telecommunications, and networking provides a vital support system in this context. It amplifies the organization's ability to act quickly on the basis of information, to position its strategic responses rapidly ('strategic readiness'), and to 'compete in time'.

Creativity of human resources is marshalled towards innovation through well-designed and planned organizational processes.

Flexibility of organization may be equated with its effectiveness. It represents the organization's capability to continuously transform its strategy, structure, systems, and processes, to respond to or cope with environmental pressures, demands, and changes in an adaptive manner (Rastogi, 1988, 1991, 1992b).

National Industrial Policy

Industrial organizations are primary institutions for creation of wealth in societies. A national industrial policy refers to the use of its authority and resources by a government to help and/or regulate specific sectors or firms to facilitate their development in perceived national interest. It requires long term planning, identification of priorities, and channeling of scarce resources toward priority areas/sectors. These may be high growth industries and/or seminal technologies that cut across industrial sectors.

Considerations such as the following enter into the policy formulation process in this context:

- What are the manufacturing competences needed by enterprises in sector X?
- What are the core or generic technologies around which strengths in product lines can be built?
- What are the few product lines in which the domestic units can have competitive advantages in exports?

A national industrial policy refers to the use of its authority and resources by a government to help and/or regulate specific sectors or firms to facilitate their development in perceived national interest.

Industrial policy is vital for encouraging firms towards technology development and innovation through well-designed incentives. In the absence of effective incentives, firms may not be able to bear the costs and risks of technovation. Nor may they be able to initiate developmental efforts in the face of market imperfections, and high investment requirements of sophisticated technologies. Firms also need government support for entering export markets, and accessing foreign sources of technology. For these and related reasons, a national industrial policy needs to be forward looking, export oriented, economically rational i.e., insulated from politicization, and facilitative of close cooperation among firms, financial institutions, academic and research organizations.

An industrial policy to be effective, must meet two basic conditions. First and foremost, it must be based on an orchestration of a set of policies pertaining to export, import technology, taxation, tariffs, higher education, labour, transport, communication, infrastructure, energy, fuel, environment, and power. Secondly, and more importantly, it must be based on a bold vision of the nation's economic future shared by all social sectors associated with the production process. The pattern of 'business-banks-bureaucracy' collaboration in Japan, is a major example in this context.

Core Competences

The foregoing requirements of the basic capabilities of world class manufacturing, technology management, and flexible organization systems, and the support system of a national industrial policy, constitute the *necessary conditions* only for the global competitiveness of companies. The *sufficient condition* is defined by the imaginative formulation, and effective implementation of

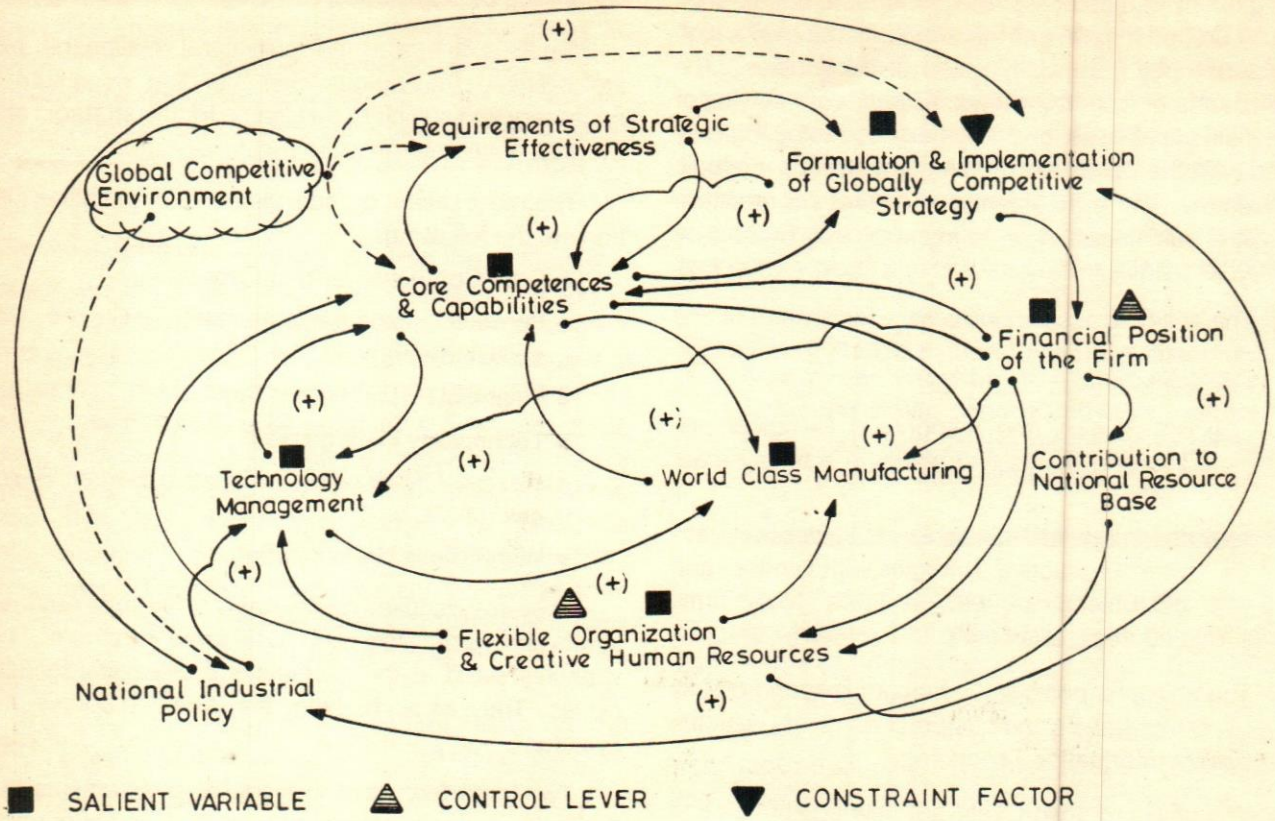

Fig. 1 Dynamics of Globally Competitive Strategy

global competitive environment. In so far as the latter is highly dynamic and uncertain, the operation of system processes also needs to be highly adaptive and resilient on the one hand, and proactive, on the other.

Lessons in Policy & Strategy

The basic capabilities and core competences are indispensable for coping effectively with the highly complex, uncertain, and changing nature of the globaly competitive environment. The 'additional' lessons merely serve to elucidate various aspects of the above fundamental requirements briefly. Their listing does not denote any particular order, sequence, or considerations of priority. The listing is also not meant to be complete or comprehensive in any specified sense.

The concept of 'value chain' characterizes a company's technological and economic activities. The value a company creates is measured by the amount the customers in a free global market are willing to pay for a product or service. The company is competitive if the value it creates exceeds the cost of value chain activities that create its product or service, and the cost is lower than that of the competing firms.

Human resources have to be viewed, developed, and used as precious assets, instead of being regarded as disposable costs.

All phases of product creation process must be effectively integrated across functions and activities. Each link in the chain from R & D to production to marketing must be as strong as the next. R & D labs and activities should be attached to operations as in Japan, instead of being attached to company headquarters, as in USA.

Business processes of the company should be transformed towards developing 'core competences' and a set of unique or distinctive cross-functional value chain or service activities' capabilities, and skills for delivering value to customer.

Technological innovation including technology fusion is the basis for continuing success. Companies must motivate their technical personnel, and foster their creative efforts, towards meeting the challenge of technovation (Rastogi, 1990).

Profits and cashflow are of fundamental importance for an enterprise, but the primacy of focus on managing a company on the basis of financial figures only, is

misplaced. These are *lagging indicators*, useful mainly for after-the-fact evaluation. Moreover, they tend to create an orientation towards short-term profit maximization that is detrimental to a long term vision. The firm must learn to focus on *leading indicators* that can be found only by examining the basic business processes and service capabilities.

Two complementary and conjoint thrusts are required for sustaining the world level competitiveness of industrial enterprises:

- Productivity and innovation
- Technological development including quick absorption of acquired technology, and technovation including fusion of existing technologies.

It takes both the thrusts to succeed in world markets in a continuing manner.[5]

Strategic readiness of a firm in terms of its ability to positing a timely and effective response to changing conditions is more important for competitive success, than planning. Such a response capability represents a major organizational strength. It requires flexible, flat, and fluid organization structure on the one hand and committed, competent, and creative organizational personnel on the other (Kantner, 1984).

Contemporary milieu of international competition in industry and trade requires adaptive corporate behaviour that is primarily driven by technology and knowledge. Technology and knowledge can however, be embodied generated, and used only by human beings. Only on the base of human resources, can the structure of core competences and capabilities be built and sustained.

Acknowledgement

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REFERENCES

Hamel, G. & Prahalad, C., 'The Core Competence of the Corporation' Harvard Business Review' May-June, 1990.

Imai, M., KAIZEN — The Key to Japan's Competitive Success, McGraw Hill, Singapore, 1991.

Kodama, F., 'Technology Fusion and the New R & D, Harvard Business Review, July-August, 1992.

Kantner, R., The Change Masters, Allen & Unwin, London, 1984.

Noori, H., Managing the Dynamics of New Technology, Prentice Hall, NJ, 1990.

O'Grady, P., Putting the Just-In-Time-Philosophy into Practice, Kogan Page, London, 1988.

Ohno, T. & Mito, S., Just-In-Time for Today and Tomorrow, Productivity Press, Cambridge, MA, 1988.

Peters, T., & Waterman, R., In Search of Excellence, Harper & Row, New York, 1982.

Powers Jr., J., Computer-Automated Manufacturing, McGraw Hill, Singapore, 1987.

Quinn, J., Intelligent Enterprise: A Knowledge and Service Based Paradigm for industry. The Free Press, New York, 1992.

Rastogi, P.N., Social & Management Cybernetics, Affiliated East-West Press, New Delhi, 1979.

Rastogi, P.N., Intelligent Management Systems, Affiliated East-West Press, New Delhi, 1986.

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

Rastogi P.N., Management of Technological Innovation, ISTE, Mysore, 1990.

Rastogi P.N., Managing New Technology, ISTE, Mysore, 1991.

Rastogi P.N., Policy Analysis & Problem-Solving for Social Systems, Sage Publications, New Delhi, 1992(a).

Rastogi P.N., Technology Policy for Productivity, National Productivity Council Research Report, New Delhi, 1992(b).

Rastogi P.N., World Class Manufacturing, ISTE, Mysore, 1992(c).

Rossel, J., The Quality Master Plan, ASQC Quality Press, Milwaukee, 1990.

Salk, G. et al., 'Competing on Capabilities: The New Rules of Corporate Strategy' Harvard Business Review, March-April, 1992.

Schoemaker, P., 'How to Link Strategic Vision to Core Capabilities', Sloan Management Review, Fall, 1992.

Schonberger, R., 'World Class Manufacturing' The Free Press, New York, 1987.

Schonberger R., 'Is Strategy Strategic? Impact of Total Quality Management on Strategy', The Executive, Vol. 6, No. 3, 1992.

Shetty, Y., & Buechler, V., Quality and Productivity and Innovation— Strategies for Gaining Competitive Advantage, Elsevier, New York, 1987.

Sreenivasan, S., 'Why IBM Stumbled', Business Today, February 22, 1993.

Staffwriter, 'From black to red, the Big Blue Story', Reproduced from The Economist, in The Economic Times, Feb. 3, 1993.

Trichy, N., & Sherman, S., Control Your Destiny or Some one Else Will, Doubleday, New York, 1992. □

5 See also Shetty & Buechler (1987) in this contest.

Non-Electrical Machinery: Domestic Competition for International Competitiveness

Jacob John

The recent liberalisation process witnessed the phasing out of various controls prevalent in Indian industry since fifties. These reforms have become very crucial for the Indian industry to penetrate and integrate with the global market. However, the domestic competition, an essential factor to enable Indian firms achieve international competitiveness, has been overlooked. Non-electrical machinery sector has been non-competitive in the global market. The removal of several tariff and non-tariff barriers that this sector experienced over the years would not enable it to achieve international competitiveness. The industry has not yet started operation in an environment of stiff competition and rivalry in the domestic market. In this context, the author explores the hurdles that hamper intense domestic competition and rivalry.

Jacob John is a Senior Executive (Economist) at ASSOCHAM, 1 Jaisingh Road, New Delhi. 110 001

Liberalisation has opened up new vistas for India's international trade but has not given the necessary impetus to domestic trade due to the lack of competition at home. Domestic rivalry plays a critical role in achieving international success world over. The dynamism and pressure created by vibrant local rivalry is the single most important stimulus to innovation and upgradation in an industry. Michael Porter's (1990) Ten Nation study' found that local competition and rivalry was imperative for both small and large countries. The study on Canada (Porter, 1991) concluded that though the Canadian government made significant strides in recent years towards instituting policies such as freer trade, deregulation and modernisation of competition laws, non-tariff barriers among provinces continue to have a deleterious effect on domestic rivalry and on Canada's international competitiveness.

Existence of domestic competitors negates basic factor advantages and forces firms to produce output of high quality.

Though the competition with foreign firms can be an important stimulus for improvement, it is not an effective substitute for domestic rivalry. Domestic rivalry motivates firms to make the necessary investments and take risks for competitive advantage. The pressure from actual rivals provides a greater stimulus to innovation than potential rivalry. The existence of domestic competitors negates basic factor advantages and forces firms to produce output of high quality and for reaping more sustainable advantages. Moreover, India has a very large domestic market which has to be catered to. Government support is a necessary factor to ensure local rivalry so as to gain international competitive advantage.

Indian Non-electrical Machinery

Non-electrical machinery forms an important part of India's engineering industrial sector producing an output amounting to the value of Rs. 97480.8 million with a net value addition of Rs. 21229.3 million (Handbook of Industrial Statistics, 1992, reproduced from Annual Survey of Industries, 1988-89). This industry, has capital investment to the tune of Rs. 58246.7 million. It shared 6.1 per cent of the total net value addition by all industries in India. However, in exports, this sector continues to generate negative trade balance since it is unable to penetrate the global market. This sector which comes under the classification of Nuclear Reactor, boilers, machinery and mechanical appliances, parts thereof, exported Rs. 12675 million in 1991-92 against the import of Rs. 37945 million generating a trade gap of Rs. 25270 million. (DGCI&S, 1992)

Protection till liberalisation

Over the years, both price and non-price measures protected domestic industries. Various studies on protection through price measures indicate that effective rate of protection (ERP) is very high in Indian industries although it varies among industries. ERP is defined as the percentage excess of domestic value-added due to the imposition of tariffs and other protective measures on the product and its input over foreign or world market value added. For the period 1968-69, non-electrical machinery experienced 87.8 per cent Effective Rate of Protection (ERP) and for the electrical machinery it was 119.6 percent (Panchamukhi, 1978). During 1980-81, the non-electrical machinery enjoyed 50.18 per cent of ERP while electrical machinery had 95.92 per cent (Goldar et al. 1992). These studies point out that though the non-electrical machinery sector operated with less ERP compared to electrical machinery, nonetheless the former was subjected to protection significantly (table 1).

Table 1: Effective Rates of Protection in Selected Industries

E.R.P. in India 1968-69	Panchmukhi's Estimates 1968-69-1980-81	Goldar & Saleem 1980-81
Non-electrical machinery	87.8	50.18
Electrical machinery	119.6	95.92

Note: There is a difference between the two estimates. Panchamukhi has taken into account both tariff and quantitative restrictions on imports by incorporating import premium into the protection estimates. Goldar & Saleem's study is based only on tariff rates.

Liberalisation & Domestic competition

The liberalisation process in India has initiated phasing out of many of the controls that protected the industry domestically. However, the extent of domestic rivalry and competition in the country remains unchanged. While certain protectionist policies are still being pursued by the government, Indian firms have been following the same strategies with regard to production pattern formulated over the years. The basic characteristics of Indian domestic market that evolved over the years have been still continuing. Many of them are not directly related to the tariff and quantitative controls. The policies of the government and the strategies of manufacturing firms that preclude domestic competition in the non-electrical machinery sector include:

- Dualism in the production pattern i.e. different types of production patterns for export and domestic market
- The reservation of many items for small scale manufactures
- Entry and exit barriers

In the global market, firms compete, not the nations (Porter, 1990), So in order to achieve competitive advantage in the global market, manufacturing firms of non-electrical machinery are required to operate in competitive domestic market.

The major non-electrical machineries are (a) sugar machinery (b) machine tools (c) power-driven pumps and (d) tractors.

In 1991 while tractors (100.02 per cent), machine tools (167 per cent) and sugar machinery (73 per cent) operated a high level of capacity, power-driven pumps (48 per cent) showed a poor performance in terms of capacity utilisation (table 2).

Table 2: Capacity Utilisation of Select Non-Electrical Machinery Industries (1989-91)

Industry	Capacity Utilisation		
	1989	1990	1991
Tractors	81.9	89.3	100.02
Machine Tools	138.0	155.0	167.00
Sugar Machinery	49.0	68.0	73.00
Power-Driven Pumps	48.0	50.0	48.00

Source: Ministry of Commerce, Handbook of Industrial Statistics, 1992, reproduced from Director General of Technical Development (DGTD), Ministry of Commerce.

Moreover, the trend over the recent years indicates that the capacity utilisation of power-driven pumps has been stagnating while for the remaining industry it has been increasing sharply. Due to its low capacity utilisation, power-driven pumps has been selected for the

detailed analysis of the factors that preclude intense competition in the non-electrical machinery.

Power Driven Pumps

Pumps are used to transport liquid and gas from one point to another; they have a wide range of uses in irrigation, water supply for drinking purposes, effluent disposal, petroleum mining and refining and in many chemical and process based industries. The users of these pumps are both industrial and non-industrial – the former constitutes basic industries like fertilisers, paper, cement, refineries etc. and strategic units like power stations and the latter includes farmers, households, public water supply authorities, etc. Basically, high-tech pumps are used for industrial and low tech. for non-industrial uses ones. Based on the principles by which energy is added to the fluid, pumps are of two types – dynamic and displacement. The dynamic pumps are subdivided into centrifugal and special effect while the displacement pumps constitute reciprocating and rotary.

Pump industry which had its origin in 1920s can be considered as a traditional industry. However, it was only with the advent of planning in 1951, the industry started to grow in our country. As a sequel to the green revolution during mid 80's, the irrigation pump segment received a stimulus. Agriculture sector has been the major end user of the industry (Industrial Researcher, April, 1988) as it consumes 55 per cent of total production, Chemical and processing sector 30 per cent, Petroleum 8 per cent, Sewage 5 per cent and miscellaneous 2 per cent.

Indian pump industry caters to both the organised sector of large and medium units and the unorganised sector of small scale units. Of late, the industry constitutes 87 units registered with the Directorate General of Technical Development (DGTD) and 500 small scale units being registered with the Directorate of Industries of different states.

Production Trend

The total production in the organised sector represented by the units registered with Directorate General of Technical Development is 0.75 million pumps in 1990 (DGTD, 1991). This indicated a significant production growth from the level of 0.36 million in 1982 and 26,000 in 1951. During 1982-90, the Compound Annual rate of Growth (CARG) of pumps in the country is 9.61%. The production of the small scale sector is very significant, but the latest production data is not available. However, during 1989-90 the small scale sector accounted for about 25 per cent of total production and assuming that this ratio remains unchanged, total production in 1990, this can be estimated roughly at 0.19 million.

Trends in Trade

India's export of pumps amounted to $ 36.1 million in 1989 and registered a 6.5 per cent rate of growth during 1980-89 as export was $ 28.1 million in 1980. However, India's share in world export of pumps remained at 0.2 per cent during this period. The worrisome aspect of India's trade is the evergrowing import and it was $ 363.7 million in 1989 registering an annual rate of growth of 18.38 per cent during 1980-89 (table 3). India's share of world import has grown from 0.57 per cent in 1980 to 1.82 per cent in 1989.

Table 3: Pumps-World trade and India's Share ($ Million)

	World Export	World Import	India's Export	India's Import
1980	14087.8	13932.9	28.1 (0.20)	79.6 (0.57)
1989	18426.4	19940.2	36.1 (0.20)	363.7 (1.82)
CARG	3.02	4.06	6.5	18.38

Source: U.N. Statistical Year book, 1989.
Note: Figures within brackets are India's share in world export/import

For industrial uses a wide variety of chemical process pumps exist but India has been manufacturing only some of them. The technology for manufacturing some pumps are not available in India and in some cases the production would not justify the economies of scale as the cost of production of just one or two high tech pumps would be very high. So India imports various types of pumps and parts, mainly high-tech pumps such as reciprocating pump engines, centrifugal pumps, pumps' oil internal combustion engines, etc. (TDA, 1991). As a result, India has become a major importer of industrial pumps. Needless to add, India is not capable of exporting chemical process pumps and other pumps for industrial uses.

India mainly exports low-tech pumps for irrigation purposes. India's export includes horizontal centrifugal pumps for irrigation, and suction split casing centrifugal pumps and components, standard pumps/components, multi stage pumps, submersible pumps, pumps for oil internal combustion engines, etc. (TDA, 1991). The pump industry shows an everincreasing negative trade balance as low-valued, low-tech water pumps are being exported against the import of high-valued, high-tech chemical process pumps and other pumps for industrial uses. In 1991-92, the negative trade balance was Rs. 438.77 mil-

lion and in the immediate previous year, it was much higher. This trend has been continuing since the beginning of 80's (table 4).

Table 4: India's Export and Import of Pumps and Parts

(In Rs. Million)

	Export	Import	Negative Trade balance
1984-85	209.15	549.7	340.55
1987-88	200.89	780.2	579.31
1990-91	469.6	1012.73	543.13
1991-92	578.23	1018.00	439.77

Source: DGCI&S, Calcutta

The Indian pump industry has been experiencing a very large negative trade balance though it is both an exporter and importer. The industry lacks a good image in the international market due to various factors such as the technology gap in the production of high tech pumps, high cost of production, etc.

Constraints to Domestic competition

The inward-looking policies pursued in India over the years and the various tariff and non-tariff controls on international trade both quantitative and qualitative, made Indian pump industry internationally non-competitive. Though the liberalisation process has removed most of these controls, the domestic competition, a vital factor for international competition, has not yet started to operate due to the following constraints:

Reservation for small scale units

The Government of India reserved the production of pumps up to 10 HP for small scale manufacturing units as a part of industrial policy statement of 1973. However, a few large units which started production before the reservation are continuing the production of these pumps. The major portion of the purchase of these categories of pumps is linked to credit availability in the agriculture sector being made by the government agencies. In addition to the reservation, the sales of pumps manufactured by Small Scale Industries (SSI) are promoted by the government by way of giving approvals to the products to be distributed amongst farmers. Moreover, in the case of the product, the minimum level of quality for obtaining Bureau of Indian Standards (BIS) has been kept down in order to help the small scale units. The small scale units can sell water pumps at lower price than large units as the farmers operate at lower overhead cost. SSI unit's products, however, do not exhibit better level of quality mainly because of inadequate facilities especially in testing. However, large and medium scale units possess quality control facilities such as destructive testing laboratory for testing of compressive, shear and transverse strength and chemical composition of material and non-destructive testing for Radiographic, Ultrasonic, Magnetic particle, dye-penetrant testing and dynamic balancing tests (DSIR, 1991). Moreover, the large and medium units avail better technology through foreign collaboration. Though large scale units are capable of producing better quality of pumps, as the result of price based competition from the SSIs' they are forced to reduce price and quality.

Though large scale units are capable of producing better quality of pumps, as the result of price based competition from the SSIs' they are forced to reduce price and quality.

On the other hand, irrigation pump segment has been facing unsophisticated demand since the farmers are ignorant of the quality of pumps. Domestic pump users also are not concerned about quality they are a little more discriminant in comparison to the users of irrigation pumps. The unsophisticated nature of the demand favours the small units selling pumps with lower quality at lower prices. The irrigation and domestic pumps characterised by low tech nature, has been witnessing the entry of a number of small scale manufacturers after the reservation. Consequently the competition is less intense and price-based rather than quality-based.

Dualism in production pattern

Indian firms export mainly water pumps and the export of high-tech pumps which has started recently is quite nominal. Most of the exporting firms are engaged in domestic sale also. In view of the stiff competition in the global market these firms pursue the strategy of manufacturing better quality of water pumps for export, by way of using raw materials of high quality. For instance, the best quality of castings is used in the manufacture of export items. Such efforts to supply better quality of pumps for exports lead to a dichotomy in the production pattern.

The government has been providing various export incentive schemes such as Duty Drawback Scheme, Cash Compensatory Scheme, International Price Reimbursement Scheme, Market Development Assistance, etc. to promote Indian exports in view of the high cost of inputs.

In the absence of sophistication of demand due to the dualistic approach in the production pattern, quality-based competition does not exist in the domestic market and domestic manufacturers find it difficult to supply products of high quality in the international market.

In the absence of sophistication of demand due to the dualistic approach in the production pattern, quality-based competition does not exist in the domestic market.

Exit & Entry barrier

Though many of the entry barriers to the industry have been removed as a result of the liberalisation process, barriers like reservation are still operating in the pump industry. In the low-tech segment (water pumps for irrigation and domestic uses), large and medium sized manufacturers are not permitted to enter due to the reservation policy. In the high-tech segment (pumps for industrial uses) while small units are incapable of entering the production, medium units face constraints due to the high technology and capital intensity needed. The buyers and users of industrial pumps are more quality conscious and purchases are being done directly by the manufacturers. However, this segment does not witness an intense competition since it is represented by few manufacturers who have been pursuing 'niche market' strategies.

Exit barriers are another constraint. Firms are still deprived of the freedom to liquidate the industrial establishment if it becomes perennially unprofitable, the underlying idea being protection of the workers. However, Indian experience indicates that it is counter productive even for the interest of the work force in the long run since the system tends to discourage fresh investment which would create more job opportunities. If domestic competition exists, a moderate exit barrier would be generated. A good competitor has exit barriers that are significant enough to make its presence in the industry a viable deterrent to entrants, but yet not so high as to completely lock in the industry (Porter, 1985). However, high exit barriers create risks that disrupt the industry. Political decision to remove these exit barriers is an imperative need to save the industry.

Guidelines for further liberalisation

For creating an intense domestic rivalry and competition, certain critical steps are required. Free entry and exit of manufacturers for all industries except for highly strategic industries has to be permitted. The reservation of some industries for small scale units needs to be done away with so as to provide easy entry to all. Streamlining and implementation of an exit policy is a dire need. Various incentives are available to Indian exporters to minimise the effects of the high cost of inputs. However, production for domestic market is still deprived of any such incentives and due to the high cost economy, the dichotomy in the production pattern has been continuing. This should lead the policy makers to ensure domestic competition in Indian Industries by reducing the cost of inputs available to the domestic industry also. However, the neglect of domestic market with regard to quality would hamper the sophistication of demand. Both Government and Industry should initiate steps to remove the dualism in the production pattern so as to integrate the domestic market with the global scene. As intense competition among the manufacturers in the domestic market is an essential factor for international competitiveness, the need of the hour is to remove the obstacles to domestic competition in order to make Indian non-electrical machinery industry sector domestically competitive.

References

Goldar, Bishwanath & Saleem, M. Hasheem (1992), "India's Tariff structure: Effective Rates of Protection of Indian Industries", National Institute of Public Finance and Policy, New Delhi.

Government of India, Directorate General of Commercial Intelligence and Statistics, Calcutta, "Statistics of the Foreign Trade of India by Countries", Vol. I Exports and Re-exports, March, 1992.

Government of India, Directorate General of Technical Development, (1992) DGTD News, "Growing Market for Pumps", Industrial Researcher, April, 1988.

Government of India, Central Statistics Organisation (1989), Annual Survey of Industries (Factory Sector) 1986-87, UN Statistical Yearbook, New Delhi.

Government of India, Department of Science and Industrial Research, (1991) Technology Evaluation and Norms Study in Pump Industry, New Delhi.

Government of India, Ministry of Industry, Office of the Economic Adviser, (1992). "Handbook of Industrial Statistics", New Delhi.

Panchamukhi, V.R. (1978), Trade policies of India — A quantitative analysis, Concept Publishing Company, Delhi.

Porter, Michael, E. (1985), "The Competitive Advantage — Creating and Sustaining Superior Performance", The Free Press, New York.

Porter, Michael, E. (1990), "The Competitive Advantage of Nation", The Free Press, New York.

Porter, Michael, E. (1991), "Canada at the Cross Roads — The Reality of a New Competitive Environment", Canada.

Trade Development Authority, March, 1991. "Export Prospects of Pumps from India", New Delhi. □

Infrastructure Development in India: An Alternative Approach to Measurement

Infrastructure is a pre requisite for economic development of a region. It is one of the major indicators to assess the growth potential of a region. 'Infrastructure development in Indian States' (*Productivity*, 33, 3, 1992), arrived at an infrastructure development index for 15 major states in India. The methodology used is similar to that of an earlier work 'Human Development in Indian States' (*Productivity*, 33, 2, 1992). We are all familiar with the Human Development Index, which is one of the novel and distinguishable features of the Human Development Report of 1990. But, to get a reliable index which can reflect the real infrastructure position of a region, the methodology used by the Research Division of NPC is inadequate since it merely takes the sum of the average deprivation of the variables used which is not altogether realistic. In the analysis by the RD of NPC, the crucial assumption made is that all the variables have equal weightage in contributing to the infrastructure of a region. The fact which is to be analysed is, whether the same type of methodology can reflect the real infrastructure backwardness of a State. This article provides a suitable alternative method for arriving at an infrastructure index.

The authors arrived at the deprivation index (I_{ij}) by using the following method:

$$I_{ij} = \frac{(\max X_{ij} - X_{ij})}{(\max_j X_{ij} - \min_j X_{ij})}$$

Here, I_{ij} is the deprivation indicator for the jth state with respect to the ith variable. Index is then calculated by averaging all I_{ij}'s and subtracting the average from 1 (here 1 means some sort of ideal state).

At times all the variables considered in developing a composite Index may not be contributing to the inter-state variability. Infrastructure Development Index must reflect the relative dominance or absence of these indicators. For this purpose, we use Principal Component Analysis (PCA) to develop a composite Index which we feel is more suitable to capture the relative weightage of different indicators. In this analysis, we use the same data from the above mentioned article by RD of NPC. The variables taken for the analysis are the following:

V_1 Length of roads
V_2 Navigable water ways
V_3 Railways
V_4 Telephone facilities
V_5 Electricity
V_6 Commercial Banking facilities

Methodology

Here, as the first step we show that the ranking by ordinal method does not take into consideration the variability of the indicators used in this method across the states. It gives equal weight to all variables (weight = 1). For an objective analysis, one has to resort to a method which takes into consideration the variability across the cases (states). We explain this point with a hypothetical illustration. Suppose we have two variable V^1, V^2, and two states D^1, D^2 (cases). Let the scores be the following:

	V^1	V^2
D^1	50	10
D^2	30	20

In the case of Ordinal ranking, the first and second variables get the same rank. The combined score of first state is 3 and that of second state is also 3. This means the two states performed in the same way.

Suppose we assign weights which consider the proportion of the variability across the cases. For illustration, by taking the ratio of *range to mean score as weight*, we find the two states getting different combined scores (first state gets a combined score of 31.6 and the second 28.2). Thus, we find that the Principal Component

Analysis (PCA) involving variability across the cases is more objective compared to the ranking with equal weights. PCA has been used earlier in arriving at a composite index of educational development for different States of India.

Principal component analysis is a multivariate method which helps in representation of multiplicity of related random variables for any observational set. It thus provides, an exploratory modelling and substantial data reduction. When a large number of variables are available for potential study it may be of interest to inquire initially whether they can be replaced by a fewer number of random variables either a subset of the original or certain functions of them, without loss of such information (Rao, 1964). If there are P random variables with large amount of variability (many large variances), the analyst may use PCA to explain or understand variability. The method essentially consists of computing such linear combinations of the original variables that capture successively, the largest proportion of variance in the original variables (Ram, Rati, 1982).

Model

A Principal Component Analysis of a set of original n variables, generates m new variables, the principal components PC_1, PC_2, ... PC_m, with each principal component being a linear combination of the S's scores of the original variables that is,

$$PC_1 = a_{11}X + a_{21}X_2 + \ldots\ldots\ldots + a_{m1}\ X_m = XA_i$$

$$PC_2 = a_{21}\ X_1 + a_{22}\ X_2 + \ldots\ldots\ldots + a_{m2}\ X_m = XA_{2i} \qquad (1)$$

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

$$PC_m = a_{m1}\ X_1 + a_{m2}\ X_2 + \ldots\ldots\ldots + a_{mm}\ X_m = XA_m$$

The coefficients of PC_1 are so chosen so as to make its variance as large as possible. The coefficients for PC_2 are chosen so as to make the variance of this combined variable as large as possible, subject to the restriction that scores of PC_1 and PC_2 are uncorrelated. In general, the coefficients for PC_1 are chosen so as to make its variance as large as possible, subject to the condition that it be uncorrelated with the scores on PC_1 through PC_{i-1}. In other words, each principal component is a linear combination of weighted original variables. This can also be written as:

$$PC_i = \sum^{m} a_{ij} * \ X_j$$

where a_j = factor loading of 'j' variables

$j = 1, 2 \ldots\ldots\ldots m$ or

It is customary to take the variables rescaled before going for PCA. Generally normalized original variables are taken, in order to avoid scale problems. Suppose we have original sets variables X_{ij}, we can arrive at a set of normalized variables

$$Z_{ij} = (x_i - E(x_i)) / \delta x_i \text{ for all } j \text{ variables}$$

Results

Principal Component Analysis of all the variables mentioned above, yielded the first factor with 49.5 per cent of variability being explained. Table 1 presents the factor coefficients of the first factor. We have used these weights to arrive at the composite index. From table 1, it can be seen that the last three variables, viz., telephone facility, electricity and commercial banks have higher weights compared to others.

Table 1: Factor Score Coefficients

1	2
V1	0.05002
V2	– 0.20109
V3	0.20174
V4	0.30974
V5	0.33181
V6	0.24641
Var. Explained	49.5%

Navigable water ways gets negative weight implying its low importance in the composite index. Table 2 compares the ranking of States in terms of PCA index and that of RD of NPC.

Table 2: Comparison of Rankings

Index and Ranking by PCA		Ranking	Computed by RD of NPC	
1	2	3	4	5
AP	–0.37659	9	AP	11
ASSAM	–0.99179	13	ASSAM	5
BIHAR	–1.28679	14	BIHAR	15
GUJARAT	1.546022	2	GUJARAT	2
HARYANA	1.14714	3	HARYANA	3
KARNATAKA	0.360215	5	KARNATAKA	6
KERALA	–0.58646	11	KERALA	7
MAHARASTRA	0.142035	7	MAHARASTRA	10
MP	–0.23243	8	MP	12
ORISSA	–0.4028	10	ORISSA	8
PUNJAB	2.271621	1	PUNJAB	1
RAJASTHAN	0.367618	4	RAJASTHAN	4
T NADU	0.198663	6	T NADU	9
UP	–0.81821	12	UP	13
WB	–1.33824	15	WB	14

Note: Col. 2 & 3 are from our analysis.
Col. 5 is reproduced from 'Infrastructure Development in Indian States', *Productivity*, 33(3), 1992.

In comparison, there is no difference in the rank of states like Gujarat, Punjab, Haryana, and Rajasthan. The rank has marginally improved in the states of Bihar, Karnataka and U.P. A substantial increase in the rank is visible in A.P., Tamil Nadu, Maharashtra and M.P. In the states of Assam, Orissa, and Kerala the rank has come down substantially whereas the fall is marginal in the case of West Bengal. It is clear from the above analysis that both the analysis show different ranks when we give due weights to the indicators used.

What is the inference from the ranking derived from the new method? Firstly, it can be seen that, ranking is based on the weights derived from the variables. The shift in the ranks observed (Index by PCA Vs Index by RD of NPC) is consistent with the general observation of industrial progress of States.

A.V. Arun Kumar & C. Upendranadh
Institute for Social & Economic Change,
Nagarbhavi, Bangalore 560072

References

Rao C.R. (1964): The Use and interpretation of Principal Component Analysis, *SANKHYA Series A* Vol 26 pp. 329-58.

Ram, Rati (1982): "Composite Indices of PQLI, Basic needs fulfillment, and Income" *Journal of Development Economics* Vo. 11 pp. 227-47. □

Goal of Technology

The goal of the new technology would be more towards a more metabolic system that eliminates waste and pollution by making sure that the output and by-products of each industry becomes an input for the next.

— Alvin Toffler

Logical Considerations in Organization of Science

S. Suresh Kumar & R. Sreenivasan

The synthesis of science and organization is not an easy task. Organizations should have a formal structure to ensure clarity of objectives and commitment of personnel to charter. The micro level of the organization interacts through a network of informational exchanges and constitutes an emergent behaviour. This metalevel requires low-level protocols for efficient behaviour. The metalevel is itself a part of the macro level of apex body and policies. The micro level can be understood only from the metal level and so forth, until at the macro level, we derive precepts and principles from a supra plane of policy-space representing an emergent super-set and incorporating global considerations alongwith local particularities and low order protocols; according to the authors.

S. Suresh Kumar & R. Sreenivasan are scientists from the Regional Research Laboratory, Trivandrum.

Scientific activity includes not only scientists and engineers involved in research and development. It also includes those employed in what may perhaps be called as science 'servicing', like planning, monitoring, information and liaison etc. With the development of 'Big-Science' projects and 'mission mode' programmes, the structure of scientific activity tends markedly to be complex, concomitantly expending a fairly large chunk of resources. More and more money is being spent on research in developing and developed nations, the former to reduce its technological indebtedness and associated foreign exchange problems and the latter to capture the lead in the competition for technological edge. Scientific activity thus emphasises an organised approach despite the implicit assumption of strains of eccentricity.

Eventhough science by its very nature is not amenable to organization, modern science depends on organizations and their networking through policies for success of personnel across disciplinary and geographical barriers and also as a means of mobilising resources so as to carry out the effort in the most optimal manner possible (Ziman, 1968).

Eventhough science by its very nature is not amenable to organization, modern science depends on organizations and their networking through policies for success.

Science & Organization

The synthesis of science and organization is not an easy task. It acts to transform the activity at every level of its structure. The individual researcher is no longer the

primary structural unit in science. The collective nature of scientific activity organises a research team at the micro level, network of interlinked scientific centres and institutions at the meta level and governing tier or the apex body for scientific organisation and administration at the macrolevel (Jequier, 1972).

The synthesis of science and organisation thus introduces an element of conformism whereas non-conformism used to be intrinsic to the scientific activity as such. Research is not compatible with conformism, but conformism is essential in organisations. This conflict is resolved usually by establishing 'extra-centres' as we find in a cursory glance of the history of institutionalization in western science. These extra-centres are formulated on the concept of an entrepreneurial approach towards science, with the researcher and the 'patron' assuming risks in a joint endeavour. These centres are usually outside the university framework and organized under the aegis of an enterprising academician or researcher with funds contributed from the society. Such extra-centres are characterised by a few leading researchers at the creative fulcrum, who are to be permitted a certain level of non-conformist behaviour. Scientific activity as a profession involves others also who are not involved in highly creative activities. Thus we have an eccentric subset, within the set of S&T professionals, with higher degrees of non-conformism associated with the sub-set population (Sheinin,1978).

Pragmatic concerns in an organisation hence require the creation of a 'normal' atmosphere of formal cooperation and conformism for the bulk of the research staff and a 'supra-normal' micro climate of tolerance for the eccentric strain; this helps to iron out the conflicts between routine business and scientific quest and betwixt conformism and non-conformism. The need for such an approach has been borne out by studies. Calvin W. Taylor, Professor of Psychology at the University of Utah in Salt Lake City, studied the atmosphere in many research and exploration development establishments. Taylor established that for the individual researcher, advance involves a growth of the responsibility spectrum (Taylor, 1972). At higher levels being responsible for more activities, a researcher is unable to concentrate and loses his capability for creative work. Commonly, those who have such a capability have the least chance of making a career. It turned out that the two were in inverse proportion to each other. The greater the number of applied new ideas to the credit of a researcher, the slower his movement on the way up. A study of the personal files in one company showed that those whose activity had been of the greatest benefit to the company has once been close to dismissal. This clearly shows that the organisational straight-jacket will only help to put a premium on mediocrity unless one wilfully provides for 'looseness' in organizational design. For example, quite a few new ideas occur to the rank and file workers. But only very few lower echelon managers are prepared to hear their subordinates, while at the higher levels more managers are receptive. A loose rather informal structure for occasional presentations of such ideas by the rank and file to the more senior cadre than the supervisory levels, will thus be more beneficial to the organisation in the long-run, than strictly hierarchic disciplined structures.

The study also established that the creative climate in an organisation is adversely affected by four factors; latent fear and distrust, restricted flow of communication, attempted imposition of motivation, and attempted control of behaviour. An atmosphere of nervousness and suspicion is created where the management lives in fear of criticisms, shuns new ideas and is apprehensive of rank and file initiatives, which is more than true for many firms. This distortion of the normal flow of information causes subordinates to conceal their ideas. Inventiveness is channelled into seeking ways of bending rules, avoidance of organisation goals etc. Imposition of motivation on individuals from outside results in stereotype thinking. The inward resistance felt by the subordinates is expressed by rebellious behaviour and indiscipline. The stricter and tougher control over behaviour at the establishment induces conformist behaviour and dampens their thinking activity.

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But scientific productivity does not improve by cooperation and coordination alone as the above studies would suggest. In fact, a fair amount of differences among colleagues that would create obstacles in cooperation can stimulate creativity and help in the solution of complicated problems. Dissimilar approaches to problem solving and style of functioning tend to increase productivity in science. Diversity is another factor which correlated with increase in productivity though upto a point. Involvement across 3 or 4 specialities could con-

tribute a drastic, almost two-fold, increase in the productive output of scientists. Thus multi-disciplinary teams and researchers working in two or three projects from different but related fields were on the average found to be more productive (Suresh Kumar, 1989).

At the same time, a fairly large degree of formalism is required at the organisational level for success. In fact, the 'interactions among fuzzy sub-sets should lead to cogency and continuity in a conformal way within the unit (Bernal, 1964). Extensive studies of the behaviour of scientists in organisations have been made in USA for the purpose of improving the effectiveness of research and development and have yielded valuable observations for comparative analysis. It was established that clearly formulated objectives, availability of essential resources without delay and an experienced group committed to organisational charter are of greatest importance for success of work (Jantsch, 1967). A judicious mix of the formal and the informal designing of structures is required (Seiler, 1965).

Harvey Brooks, a recognised theoreticism of U.S. Science Policy has brought out the following distinctive features of leading scientific organisations:

- Full awareness and general acceptance of the principal goals of the organisation by its key people
- Willingness to consider and implement new ideas and initiatives on their own merits, regardless of the organisational level at which they originate, or whether they come from inside/outside the organisation.
- Mobility of people between the more fundamental and applied activities.
- Quick recognition and funding of new ideas
- Extensive freedom at each organisation level to reallocate resources within the relevant area of responsibility
- Full communication through all stages of research and development process
- A good organisation memory for enduring technological problems and themes related to the broad mission of the organisation or laboratory
- A system of recognition and reward that assigns highest significance to technical contribution to the goals of the organisation.

Success comes to scientific organisations that function as open-ended systems and create the most favourable information and communication atmosphere for their research staff. The largest industrial laboratory in the USA at Bell Telephones requires that scientists and research engineers taking a job should have the following qualities; knowledge, ability for self-education, an inquiring mind, a capacity for observation, a good memory and intellectual honesty, sceptism imagination, enthusiasm and perseverance. In their relations with staff, members of management are advised to bear in mind that each needs to be encouraged for good work, wants to know about the prospects ahead, and does not like to be pushed around (Brooks, 1968).

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Motivation

Any discussion on the relationship between man and organisation should touch upon the topic of motivation. A researcher is motivated by the work content and the organisational climate. The attitude of the chief and colleagues to the task at hand has a direct influence on his working mentality. There is a direct connection between internal sources of motivation and identified quantifiable parameters of scientific productivity like publications, internal reports, overall benefit to laboratory, and overall contribution to science (Suresh Kumar, 1989).

Autonomy in functioning is an important factor in motivation, but only upto a point. The optimum measure of autonomy is determined by the fact that the worse indicators of productivity resulted from the chief's personal direction, rather than from decisions taken together by the chief and the researcher or by the latter with his colleagues (Rand, 1964). A motivated scientist is, needless to say, more productive than a demoralised group.

Unit & Systems

The micro-level of organisational design having been dealt with, we now come to the meta-level of networked systems. Organisations as nodes should couple in a complementary way to constitute the meta-level networking. One is reminded of Niel S. Bohr's complementary principle in this context (Bohr, 1958). This states that in order to obtain a general solution, one has to go beyond the framework particularities when it is just being formulated, since otherwise only a particular conclusion will

follow from particular premises. Thus no system can be understood within its own framework. One has to complement it with a system of higher order. This holds true not only at the micro-level of research teams or the individual organisations and their involvement in problem solution, but also at the metal-level of scientific network and their inter relatedness, as well as at the macro-level of apex organisation. The effectiveness of S&T policy thus depends on the stability and effectiveness of co-ordinating linkages between the elements and the system (Sheinin, 1978).

Some important linkages here are:

- That among Governmental Ministries
- Within Ministries extending from decision makers to consumers
- Between related public and private agencies
- Among private organisations and other agencies who utilise S&T
- Between Governmental agencies and internal agencies

Institutes that are not integrated into a linked-up network are unlikely to be able to make significant contributions. Evidently, research institutes depend on the Universities for supply of trained personnel, on potential users for identification to technological needs, sponsorship of programmes and utilisation of results. In developing the Science and Technology system of a country, it is important to adopt a strategy of first developing effective linkages between interested organisations and then create the missing elements within the system.

In developing the Science and Technology system of a country, it is important to adopt a strategy of first developing effective linkages between interested organisations and then create the missing elements within the system.

The organisations interact through informational exchange and communications among the nodal points in the network of science centres to constitute emergent behavioural patterns (Majone, 1990). The non-linearities in the two-body interactions result in co-operative self-organising structures, that depict supra planes in structural relations to the organisational nodes. The organisations and their network should be designed with protocols at the micro and macro levels so as to 'mesh' in with this emergent dynamics (S. Forrest, 1990). At the micro level, this is concerned with the individual and the organisation as well as motivational aspects already mentioned.

The Japanese system measures admirably well upto this criterion. Cooperative mechanisms like Quality of Function Deployment, quality circles, and concurrent engineering techniques have not only served as innovation methods but also in improving cross-communication and the quality of up-front activities. For example, QFD provides a platform for different groups to interact effectively. Their familial organizational set-up also encourages attitudes of organisation loyalty, work commitment and commaraderic. They have reward and punishment structures which are merit discriminative and proactive based on key result area approach and devised to accommodate exceptions within the conformal set without disruptions to the system as a whole.

Similarly, from the developing world context, Chinese S&T policies reflects how macro-level apex systems can mesh in with the superest of internationalizing and globalizing, patterns, without losing on the locality-specific plus points. This conforms to the concepts of Godels incompleteness Theorem as well as the Popperian Concept of Policy-Space (Majone, 1990); people and organizations are not the agents of change, but policies structure, events and interfaces are.

Conclusion

Organised science in one way or the other is bound to improve man's life immensely. But the degree of this impact is correlated to the way in which science is organised so as to enable the scientists to work with the greatest efficiency and the society to derive the maximum benefit from their activity. The need for conformism in organisation has to be coupled with the creative need for freedom. Scientific integration is achieved on the one hand by means of rational organization that takes into account the situational variables and its intrinsic premises, provides for efficient information service and permits effective communication.

The micro and macro levels in science organisation interact through a meta-level represented by a network of scientific centres and institutions. The scientific activity development thus represents a networking progress. Every organisational structure thus consists of a hierarchy of levels. The elements of the micro level are also elements of the meta level in its subsets to use the language of the theory of sets (Stoll, 1961). The elements of the

meta level like science centre, comprehensive programmes, intersectoral or multi-institutional projects, are part of a sub system of the macro level of science policy. Any analysis of the micro level organisation also involves the meta level scientific networks. Mathematical logic says that only a particular conclusion follows from particular premises. To obtain a general solution, one has to go beyond the framework of particulars when it is just formulated. Also the dynamics for non-linear interactions among the network nodes introduces co-operative behavioural patterns, which complements the system with another one of higher order.

The need for conformism in organisation has to be coupled with the creative need for freedom.

This means that as human knowledge is diffused, the external element is increasingly converted into an internal one only to be reconverted on a higher level. Problems in any sphere are thus tackled by transition to a higher order system of self-organized control. We should seek solutions to the fundamental problems in science policy on this external complement principle. But the transfer of any problem from the framework of a given system to a broader framework of meta system can be effected only at the risk of introducing infiniteness, or incompleteness, which are best resolved for overall network effectiveness through appropriate low-level protocols at the individual, group and nodal levels'. At the macro level of apex policies, one has to derive principles and precepts for protocol planning from a super set of policy-space which is the structural outcome of emergent and universal behaviour. Even while focussing on local problems, one has to adopt internationally acclaimed methods of evaluation. The scientists cannot overlook commonly accepted protocols even while being different.

References

1. **Bernal J.D.**, The Science of Science, London, 1964.
2. **Bohr Niel S.**, Atomic Physics and Human Knowledge, NY 1958, p. 99.
3. **Brooks Harvey**, Governing of Science, Cambridge (Mass) 1968.
4. **Cohen Paul J.**, Set Theory and Continuum Hypothesis, New York, 1966.
5. **Forrest Stephanie**, Emergent Computation, Physica D. 42, 1990.
6. **Jantsch Erich**, Technology Forecast in Perspective, OECD, 1967.
7. **Jequier N.**, New Problems in Science Policy, Management of Research and Development, Paris Ed. N. Kaplan, 1972.
8. **L. Majone**, Policies as Theories, International journal of Management Science, 1990
9. **Rand Christopher**, Cambridge, USA, Hub of a New World, NY 1964.
10. **Seiler, R.E.**, Improving the Effectiveness of R & D, NY, 1965.
11. **Sheinin Y.**, Science Policy, Problems and Trends, Moscow, 1978.
12. **Stoll Robert R.**, Sets, Logic and Axiomatic Theories, San Francisco, 1961.
13. **Suresh Kumar S. & Damodaran A.D.**, Productivity, 29(4), 1989.
14. **Taylor Calvin W.**, Climate for Creativity, N. York, 1972.
15. **Ziman J.M.**, Public Knowledge, Cambridge, 1968. □

Improvement of Quality of Worklife at Microlevel

Subratesh Ghosh

Quality of worklife embraces significant aspects of work related activities including the work environment, monetary compensations for work, hours of work, scope of progression, benefits, welfare services etc. The present study is a hitherto-unattempted venture in measuring the quality of worklife in Indian organizations and determining the factors which have an impact on it with a view of identifying ways of improving quality of work life to enhance productivity.

Subratesh Ghosh is a retired Professor of Personnel Management Indian Institute of Management, Calcutta.

For more than two decades, a sizeable volume of literature has developed on quality of worklife (QWL). In India also, scholars as well as practitioners of human resource management and industrial relations have studied its various aspects and developed a few case studies. However, no comprehensive attempt has been made so far in India to objectively measure the quality of worklife in Indian organisations and to develop a suitable theoretical frame for its assessment at micro-level, in the context of a less developed economy, or to examine the determinants of QWL in that specific context. No attempt has also been made to identify the approaches that should be useful at the micro-level, for improvement of QWL. The present study is an attempt to meet these deficiencies.

The study has been undertaken with the following objectives:

- *Development of Tools for Measurement and Evaluation of QWL:* To develop an objective and comprehensive assessing mechanism for evaluation of QWL in an organization, which may be used also for comparison with other organisations.
- *Determinants of QWL:* On the basis of the study of QWL in selected sample organisations in India, the study aims at developing a theoretical frame to identify the *determining factors* which govern the quality of working life in an organisation.
- *Methods of Improving QWL:* In the light of inputs from above and the inputs available from the survey of organisation and other sources, the study also aims at exploring the ways and means for improving quality of worklife at micro-level in the Indian context.

Methodology

The study has used qualitative as well as quantitative data derived from primary and secondary sources. The primary data and information have been collected on the basis of a stratified random sample survey conducted among manufacturing, mining, power generation and service sectors, covering both public and private enterprises. The stratification has been based on the sector and the nature of ownership in each sector. A structured questionnaire (Appendix 1) was mailed to 50 randomly selected sample organisations which appear to have some QWL activities out of 248 public enterprises under Central Government and different States. The same questionnaire was mailed to 31 randomly selected sample organisations out of 154 private enterprises, which were known to have types of quality of worklife programmes. Out of these organisations, we could get usable responses from 7 public enterprises and 6 private enterprises. Besides them, 2 organisations sent incomplete or inadequate responses which could not be used for this study. In addition to the sample survey, 2 case studies (1 privately owned manufacturing organisation and 1 public sector bank) were also conducted out of the responding organisations for the purpose of additional in depth analysis of the data received from them (Ghosh, 1992).

As the quality of worklife depends greatly upon qualitative factors and some of the information were by nature mainly quantitative, this study, instead of relying on the qualitative techniques of analysis, relied greatly on systematic methods of qualitative research, particularly on the *grounded theory* and the methods of qualitative evaluation. For our inferences, we also used the methods triangulation (Patton, 1990), i.e, mixing of quantitative and qualitative methods at different levels. The consistency of different data was checked with the help of triangulation of sources, including the employers, trade unions, individual employees or managers and also secondary data from published literature or unpublished materials available from the relevant organisations.

Concept of Quality of Worklife

As the theories and concepts in human resource management cannot be divorced from the socio-economic reality of the environment, each country should examine the relevance of the alternative concepts of quality of worklife as its own context (Ghosh, 1991). On examining the literature on the quality of working life, one may find a narrow concept of QWL existing side by side with a broader concept. The narrow concept confines QWL mainly to workers' participation in decision-making, or some version of job enrichment and/or satisfaction. For instance Maccoby (1984) defines quality of working life as "a commitment of management and union to support localised activities and experiments to increase employee participation in determining how to improve work Delamotte & Walker (1974) hold that quality of worklife invites attention mainly to the workers' need for meaningful and satisfying work and participation in decisions that affect their work-situation. In fact, it has been pointed out that in the English-speaking countries, where the term "quality of working life" was first coined, top priority was frequently given to job contents and work organisations, and improvements in such areas were accepted as improvements in the quality of worklife (Takezawa *et al*. 1982).

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As against this, Walton (1975), while identifying the criteria to measure quality of worklife recommends a much broader concept of QWL, proposing eight conceptual categories (viz., adequate and fair compensation, safe and healthy working conditions, immediate opportunity to use and develop human capacities, opportunity for continued growth and security, social integration in the work organisation, balanced role of work in the total lifespace and social relevance of worklife). In Japan, Takezawa and his colleagues (1982) in a research study held that "in a wider use, the quality of working life may embrace all the possible aspects of work-related life, including wages and hours, work environment, benefits and welfare service, career outlook, human relations etc. that are relevant to worker satisfaction and motivation. In a developing economy like India, it is the broader concept of QWL that is relevant. In an industrializing country, the inflationary pressure of development tends to outpace the growth of money-income, which also remains inadequate for the vast majority of employees due to the maldistribution of incomes. Hence, in such a country most of the employees (including many white-collared employees, professionals and skilled blue-collared workers) receive less than what is adequate for a decent standard of living. Thus, here the quality of worklife has to depend on adequacy of the compensation for work and the environment of work and safety in the workplace (Ghosh, 1991) in

addition to the factors connected with work design and other job enrichment categories as well as the participative mechanisms.

Contents of Quality of Worklife

In the present study we have adopted the broad concept of the quality of worklife for the purpose of measurement, conceptualisation and evaluation. Accordingly, the questionnaires issued in connection with our sample survey and case studies covered QWL categories, such as small group participative activities, joint consultation forums and other joint committees at the plant level, the work environment including safety, pay and wage-incentives, human resource development system including training, manager development, career planning and development promotion system, employee welfare schemes, the constitutionalism in the workplace as reflected in the disciplinary procedure and the grievance mechanism, determination of terms and condition of work by collective agreements, the level of job satisfaction, attendance and discipline level of the employees and their commitment to the organisation. All these categories are important in the quality of worklife. The work environment and safety system, no doubt, affect the quality of worklife as good work cannot be possible if the work environment is uncomfortable or unhygienic or if the work hazards are great. Similarly, small group participative activities (e.g. Q.C. etc.) and other participative forums greatly affect QWL as they enrich the job and enable the employees to realise their own significance in the work-related decisions, some of which, through their suggestions and involvement may remove the difficulties and irritants associated with work and may improve the working conditions. The employees' ability to improve the terms of their employment through collective agreements also help in improving the QWL in a similar way. Their pay and incentive earnings also naturally affect their QWL as the typical impetus to work is to earn a living and good pay as well as incentives may help in their motivation to greater productivity (Walton, 1975). Similarly, employee training and other human resource development measures by developing the proper attitudes, knowledge about the work and its significance and improving the skills to achieve better work-accomplishments contribute to the quality of life at the workplace. A good performance appraisal system and the connected employee counselling and the promotion system help the process of advancement which greatly contributes to the job enrichment and job satisfaction. And last but not the least, the quality of worklife can be greatly enhanced by developing constitutionalism in decision making and the organisation of work. This is so because the arbitrary decisions in matters of discipline, employee grievances, rules of attendance, leave of absence etc. and also a poor work system causing monotony and alienation create discontent and frustration among employees. Information regarding the level of these matters and the management's perception about them provide valuable clues to the quality of worklife in any organisation.

Employee training and other human resource development measures by developing the proper attitudes, knowledge about the work and its significance and improving the skills to achieve better work-accomplishments contribute to the quality of life at the workplace.

Findings of the Sample Survey

As we already indicated, in our survey of quality of worklife (QWL) in Indian organizations, we got responses to our structured questionnaire from 13 organisations out of a sample of 81 organisations chosen by random sampling from a population of 402 organisations, covering the public sector as well as private sector. Out of these 13 responding organisations, 7 belonged to public sector and 6 belonged to the private sector. Altogether, there were 8 manufacturing organizations (3 in chemical industry), 1 in automobile industry, and 1 in electrical engineering, 1 in electronics, 1 in pharmaceutical industry and 1 synthetic textile unit), 1 mining organisation, 1 bank, 2 non-bank financial organisations and 1 power generating organisation, 7 of these responding organisations, were large in size (employing 501 or more employees), 5 medium-sized (between 300 to 500 employees) and 1 small enterprise (employing less than 300 employees).

Level of Quality of Worklife

From the response to our questionnaire, we found that these organisations were engaged in various types of activities which affect quality of worklife according to the broad concept adopted in this study. Briefly, the categories studied covered the management's perception regarding the significance of QWL in organisational effectiveness resulting in the management's support to and involvement in QWL activities, participative small group activities in respect to the terms and conditions of work affecting QWL (as reflected in the collective agreements), the variables affecting work-culture, work environment

and the safety system at the workplace. In addition, data were also collected about labour productivity (output/employment) and sales so that these factors reflecting the organisational effectiveness may be assessed in relation to the QWL level prevailing in the organisation.

Tools for Measurement & Evaluation of QWL

For assessing the QWL level, the factors reflecting QWL activities assigned scores according to the quality of each factor compared to the maximum marks for each. The maximum marks of each factor reflecting QWL categories covered by the responses to the questionnaire 1 are as follows:

	Category	*Maximum Marks*
1.	Voluntary Participative Group Activities	4
2.	Management sponsored forums for participation	2
3.	Productivity gain sharing and/or incentive wage plans	2
4.	Other job enrichment programmes (excluding 1 & 2)	2
5.	Employee welfare schemes of the organisation	1
6.	Employment security system	1
7.	Training & Development System	1
8.	Career Planning System	1
9.	Formally documented Promotion Policy	1
10.	Grievance Procedure	1
11.	Disciplinary Procedure	1
12.	Formal Recruitment and Selection Policy	1
13.	Collective Agreement Clauses on Terms of Work	7
14.	Scope of Direct Interaction between Management Personnel and Employees at/outside workplace	1
15.	Impact of QWL on productivity, sale etc.	4
		30

Non-existence of such activities carried zero mark and the same was the mark for the absence of the management's perception about the influence of the QWL on the effectiveness variables, e.g., productivity, sales etc.

The actual scores assigned to these categories in each organisation have been converted into qualitative grades according to the following ranges of total scores obtained:

Marks scored	*Grade obtained*
21 and above	A (High)
15 to 20	B (Medium)
11 to 14	C (Low)
10 or less	D (Very Low)

On the basis of the analysis of data from the responses (also verified in sample cases from other sources) 5 out of 13 organisations were assigned "A" grades, 4 "B" grades, 3 "C" grades 1 "D" grade (table 1).

Table 1: Level of QWL in Sample Organisations

Sector/Ind.	QWL Grade A	B	C	D	Total
I. Public Sector:					
(1) Elec. engg.	—	—	1	—	1
(2) Pharm.	—	1	—	—	1
(3) Chemical	1	—	—	—	1
(4) Power	—	—	1	—	1
(5) Bank	1	—	—	—	1
(6) Non-bank FI	—	1	—	—	1
(7) Mining	1	—	—	—	1
Total of I.	3	2	2	—	7
II. Private Sector					
(1) Automobile	1	—	—	—	1
(2) Electronics	—	1	—	—	1
(3) Chemical	—	1	—	1	2
(4) Synthetic Textiles	1	—	—	—	1
(5) Non-bank FI	—	—	1	—	1
Total of II	2	2	1	1	6
Total (I+II)	5	4	3	1	13

Among five organizations having "A" grade QWL, 4 belonged to the large-sized organisations and 1 was medium-sized. Out of the four "B" grade organizations, 1 was large-sized, 2 medium-sized and 1 was small unit. Three organisations with "C" grade QWL included 1 large unit and 2 medium-sized units. The only organization having "D" grade QWL was a medium-sized unit.

From the survey, it may be derived that the level of quality of working life does not depend on the nature of ownership i.e., public or private. Depending on the nature of the factors affecting the QWL, both public and private enterprises may have excellent, good or inferior quality of QWL. However, attainment of excellent of grade of QWL (i.e., A grade) being dependent on the need for some investment in human resources and working conditions, it may be difficult to be achieved by small organisations whose financial resources are limited. However, for the large-sized or medium-sized organisations, attainment of

"A" or "B" or "C" quality of working life is quite possible, depending on the strength and nature of various determinants of QWL. Very poor (D-grade) QWL was found in one sample organisations which was medium-sized. But it might be possible that many of the small, medium or even large-sized organisations, which preferred not to respond to our questionnaire, actually had very poor quality (D) of QWL, which they knew, but did not want to disclose.

Other Findings of Survey

On the basis of the information collected through the main questionnaire of the survey, we obtained data about the sector (public or private), the industry/service groups to which the responding units belonged, the employment and the value and (physical) volume of output for 3 years preceding the survey. In addition, the questionnaire (Appendix 2), generated information about the following categories:

- *Management Perception* (MP) regarding the role and significance of quality of working life (QWL) activities in promoting the organisational effectiveness.
- *Employee participative* (voluntary or management-sponsored) *activities* and other job enrichment measures.
- *Organisational Effectiveness* as reflected in labour productivity, and quality of products/service (as perceived by the management).
- *Work-culture* in the organisation as indicated by the level of absenteeism, discipline, employee commitment to the organisation and job satisfaction, as perceived by the management. Employee commitment was further verified by supplementary information sought from the companies through letters (and obtained in some cases) regarding separations of employees due to voluntary resignations and other causes for the last 3 years.
- *Safety-environment and work-environment* as reflected in the level of accidents and occupational sickness respectively, according to the management's data.

Through the qualitative research technique of "open-coding" combined with actual score obtained for the category concerned by an organization according to the responses to the questionnaire, the "locations" or magnitudes of each of these categories (high, medium or low) were identified for the sample organizations. For each category, the actual scores for the components of that category obtained by the organization, were added to yield a total score for that category, which in comparison to the maximum score for the category, yielded a grade or locational magnitude (high, medium, low etc.). Example: Components of PJEA (participative group and other Job Enrichment Activities) are: (i) Voluntary Team Building or Group Activities e.g., QC, (ii) Job enrichment programmes and (iii) Sponsored Team Building programmes e.g., joint management councils, joint productivity committee etc. On the basis of the responses to the questionnaire, the scores actually obtained by the organization for each component compared to the maximum score for the same may give the location or magnitude of PJEA category for that organization. These "locational" magnitudes were then examined in association with QWL grade for each organization to identify the nature of their relationship with QWL for each of the following pairs of categories, viz., (i) management's perception regarding QWL's role (MP) and the actual grade of QWL in the organisation, (ii) participative group and other job enrichment activities, (PJEA) and the QWL grade, (iii) work-culture, (WC) and QWL grade, (iv) organizational effectiveness (OE) and QWL grade and (v) the environment of work and safety (WE-S) and the QWL grade. The summary of these relationships is given in table 2.

Among the above-mentioned categories, one is the core-category which is an independent variable governing the QWL as a dependent variable. The necessary condition for the choice of the core category is that it must have positive relations with QWL in all cases and no zero relation in any case. With two or more categories (inde-

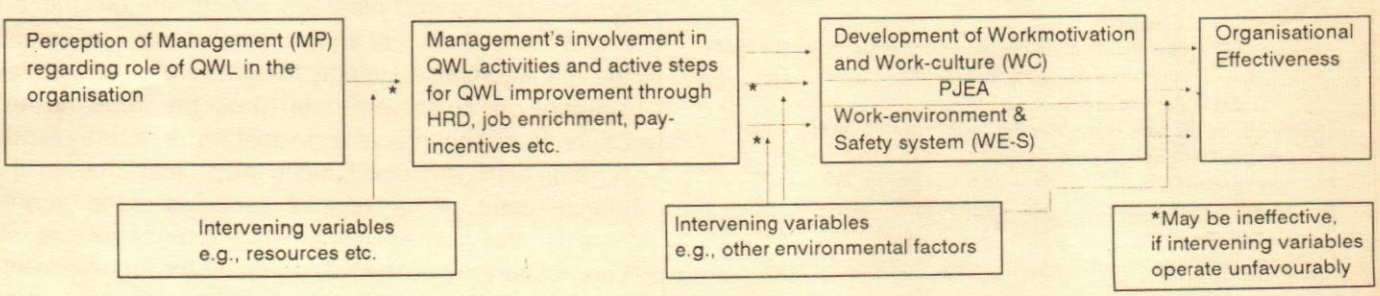

Fig. 1. Impact of the Management's Perception about QWL on Effectiveness

pendent variables) having uniformly positive relations with QWL, the category having greater number of uniformly positive relations should be chosen, provided that the sequence of causation clearly follows from the independent category of the QWL as the dependent category.

It appears from table 2 that of all pairs of categories, the relationship is the strongest between the management's perception about the role of QWL in organisational effectiveness (MP) and the QWL grade. Out of 13 organisations which responded to the questionnaire, the relationship was positive in all cases including uniformly positive association in 6 cases, medium positive in 5 cases and low positive in 2 cases. In no case was the relation found to be zero.

Table 2: *Relationship between different Categories and QWL*

Category Sector/Organisation	PJEA & QWL	OE & QWL	MP & QWL	WC & QWL	WE-S & QWL
1. P.S.-Bank:	M(MP)A	H(UP)A	H(UP)A	H(UP)A	H(UP)A
2. P.S.-NBF1:	L(LP)B	M(UP)B	M(UP)B	H(MP)B	NA(NA)B
3. P.S.-ELEC:	M(LP)C	M(LP)C	M(LP)C	H(ZR)C	M(LP)C
4. P.S.-CHEM:	L(ZR)A	H(UP)A	H(UP)A	H(UP)A	H(UP)A
5. P.S.-MING:	H(UP)A	M(MP)A	M(MP)A	L(ZR)A	M(MP)A
6. P.S.-PHARM:	M(UP)B	M(UP)B	H(MP)B	H(MP)B	H(MP)B
7. P.S-POWER:	L(UP)C	L(UP)C	L(UP)C	M(LP)C	H(ZR)C
8. Pr.-S- AUT:	H(UP)A	H(UP)A	H(UP)A	H(UP)A	H(UP)A
9. Pr. S-NBF 1:	L(UP)C	M(LP)C	M(LP)C	M(LP)C	M(LP)C
10. Pr. S-ECTN:	L(LP)B	H(MP)B	H(MP)B	H(MP)B	M(UP)B
11. Pr. S-TEX:	M(MP)A	H(UP)A	M(MP)A	H(UP)A	H(UP)A
12. Pr. S-CHEM:	L(LP)B	M(UP)B	H(MP)B	H(MP)B	H(MP)B
13. Pr. S-CHEM:	L(UP)D	L(UP)D	L(UP)D	M(LP)D	M(LP)D
Summary of Relations	UP = 6	UP = 9	UP = 6	UP = 4	UP = 5
	MP = 2; LP = 4	MP = 2	MP = 5	MP = 4	MP = 3; LP = 3
	ZR = 1	LP = 2	LP = 2	LP = 3	ZR = 1; NA = 1
				ZR = 2	

Notations: UP = Uniformly positive relations, and magnitudes of both categories are similar.
MP = Medium Positive, as one category is high other is medium
LP = Low Positive, as one category is low or very low and the other category is medium.
ZR = Zero relations
Letters within the brackets show the relationship between a category and the quality of working life.
A = High grade QWL
B = Medium grade QWL
C = Low grade QWL
D = Very low grade QWL
H = High location category
M = Medium location
L = Low location

The association between organizational effectiveness (OE) and the QWL was also found as strong, having been positive in all 13 cases, with uniformly positive (UP) association in 9 cases, medium positive in 2 cases and low positive in 2 cases. However, as the questionnaire solicited data about the impact of QWL activities on the OE variables (i.e., output, productivity and product/service quality), the causation sequence in the data was obviously from QWL to OE and not *vice-versa*. Thus as this study is interested in identifying the determinants of the level of QWL in order to seek the ways for improving the same, for the purpose of finding the core category of the study (which, here in study, has to be an independent variable affecting the QWL as its dependent variable), we have to identify the management's perception about the QWL's role (MP) as the core category, instead of the organisational effectiveness (OE).

The sequence which indicate how, subject to the operation of some intervening variables, the management's perception about the role of QWL and their resulting involvement may lead to greater organizational effectiveness is presented in Fig. 1.

Conclusions on the Survey-Findings

The findings of the sample survey indicate that the core determinant of the quality of worklife in an organisation is the management's perception about the role of QWL in affecting the organization's effectiveness. If the perception is positive and high (or at least medium), the quality of worklife tends to be high or medium, depending on the magnitude of the other major determinant of QWL viz., work-culture, and the nature of other intervening variables. A high or medium perception of the management about the QWL's role would naturally lead to the active management involvement and support for improvement of QWL, which may be broadly classified or categorised into factors affecting the *work-culture and motivation* (e.g., discipline in the workplace, features of attendance, such as absenteeism, regularity, punctuality etc., employee's commitment to the organisations, their job satisfaction, their pay and incentives etc.) the *participative group activities and other job enrichment programmes,* and *work-environment and safety system.* The extent of the management's support to and involvement in QWL activities due to its perception about the same, however, depends on the intervening variables, e.g., the resource position of the organisation and the professionalism of the management. If the financial resources of the organisation, or the human resources (in terms of the skill, knowledge etc.) of the management for improvement of QWL are limited, or if the management's professional orientation is low, its awareness of the significance of

QWL may not lead to the desired improvement. Hence much depends at this stage on the intervening variables. Again, even if these variables and the management's perception lead to active intervention by management and its support for QWL, some of the desired improvements in QWL factors may be retarded by other intervening variables operating from the environment, e.g., industrial relations, political climate and the socio-culture factors affecting the employee's attitude towards QWL improvement activities. However, if the existing level of work-culture or employee-motivation is already high or medium, this criterion may withstand shocks from the adverse intervening variables to a great extent. That is why in the sample-units covered by our survey, we found that high or medium management perception was relatively more effective in developing management's support and involvement for further improving the work culture and motivation, compared to the improvement of other QWL factors. The subsequent improvement of these QWL factors then can be effective in improving the labour-productivity, product quality and output etc. leading to the organisation's effectiveness.

Methods for Improving Quality of Worklife

Thus the management's perception regarding QWL's role, the participative activities (voluntary or management-sponsored), work culture and motivation and the environment of work and safety determine the extent of improvement of QWL. Hence the ways in which these determining variables are strengthened, or made more effective, actually indicate the methods, or mechanisms that can improve the quality of worklife in any organization.

Thus management's perception regarding QWL's role, the participative activities (voluntary or management-sponsored), work culture and motivation and the environment of work and safety determine the extent of improvement of QWL.

For improving management's perception about the role of QWL, the main instruments may be the human resource development (HRD) efforts by the management and assignment of due importance to HRD and QWL functionaries in the management hierarchy as reflected in their relative ranks in the organization structure. The HRD effort may take the forms of management development programmes on QWL, the development of team building activities, interactions with other organizations having successful QWL experiments and in-house research undertaken for understanding the scope of QWL and its linkages (or the scope for it) with the organization's strategic plans and corporate objectives. Attempts to develop professionalism at all levels of management would also be useful in this respect. If the managers in charge of QWL activities under HRM and HRD are assigned relatively higher ranks, QWL and HRD would be taken more seriously in the organization. Otherwise if left to relatively lower level or lower-middle level of managers, the senior managers and line-management functionaries would not take QWL matters seriously.

As QWL's effectiveness to improve the organization's performance may be helped by participative group activities as well as job enrichment (subject to the nature and operation of intervening variables), the active sponsorship of joint-committees and other forums for employees participation in decision-making by the management may be helpful in improving the level of QWL as well as the management's perception in respect of labour management relations and QWL through greater interaction with employees. The management need not interfere in the team building or voluntary small group participative activities like Quality Circles or work-redesign groups. But their support to the growth of such groups may be highly useful. Similarly, the management's active interest, and whenever needed, involvement in various forums of the job-enrichment activities would also be good instruments to improve QWL and its effectiveness.

Since industrial relations climate in the organization works as an important intervening variable affecting effectiveness of the management's support, to, or involvement in measures to improve QWL, the measures to develop collective bargaining and resulting collective settlements may be helpful in this respect. The terms and conditions of work (e.g., pay, benefits etc.) affecting QWL, and those for improvement of work-environment and safety should be settled through collective agreements to remove any possible doubt, or antipathy of the organized employees in these matters. The management's involvement in socio-cultural activities in the community affecting the living environment of the employees also deserve mention in this connection. The case-studies on QWL at TELCO and Canara Bank, which we conducted, lend support to these considerations. Both these organizations, despite the differences in their ownership, nature of activities and background, have high levels (A-Grade) of QWL as a whole. In both these organizations the management had been highly professional and both had good managerial

perception regarding QWL's role as is evident from their corporate objectives, the support to QWL, or small group activities, active job-enrichment measures, effectively functioning forums for employee participation in decision making (joint committees at different levels, staff meeting etc.) good industrial relations climate, substantial investment of resources in HRD efforts etc.

However, the difference in work-culture and management's perception did affect the difference in some of the important variables affecting QWL, such as the vitality and growth of the small-group participative activities and work environment. While TELCO, Jamshedpur, had uniformly good work-culture in all its divisions and offices, and among employees of all linguistic or ethnic group, the work-culture in different regions of Canara Bank substantially differed. South-Indian branches had much better work-culture among the employees, compared to say, East-Indian branches. The consequence of this regional difference, actually has been reflected in the work-environment, employee discipline and attendance etc. And for the Bank as a whole, the average of QWL categories were relatively lower than their average levels at TELCO as a whole. This difference in work-culture and possibly relative differences in management's perceptions and involvement in QWL activities also had their reflections on the growth and vitality of the voluntary small group activities in these two organizations. Although there were highly dedicated managers at the top and other levels of management committed to the development of QWL at Canara Bank, the awareness and involvement in QWL for some higher level managers, including some at the top, was definitely greater at TELCO, than what was perceived by the author at Canara Bank.

The consequence of these differences appears to have been well reflected in the differences in the relative growth of voluntary small group activities viz. Quality Circles (QC) at Canara Bank and Small Group (SG) Activities at TELCO. While TELCO in 1991 had about 1200 SGs covering about 50 per cent of total number of employees, Canara Bank, inspite of some very active Quality Circles, had QCs in about 100 branches only, out of 2005 branches throughout India, covering less than 10 per cent of its total employees. Many of the QCs, including some in effectively functioning branches, had a short life in Canara Bank, whereas the longevity of TELCO's SGs is definitely greater. Apart from the Small Groups, TELCO's Suggestion Scheme for the employees has great reputation for effectiveness. In 1990-91, TELCO received a total number of 87,827 suggestions regarding job-related matters, out of which 11 per cent was implemented. During his visit to TELCO, the author was impressed with the keen interest taken by the heads of Divisions and other senior managers in the operations of the Suggestion Scheme and SGs. The extent of involvement of employees in the Suggestion Scheme is apparent from the fact that in 1991, the number of suggestions per employee was 4.17 and out of total number of about 88 thousand suggestions, 43 per cent came from the shop-floor operatives and 40 per cent from other staff and supervisors. Although quite vibrant, Canara Bank's Suggestion Scheme has not yet been able to achieve the same measure of success. This appears to be due to the sustained management development emphasis regarding QWL and TQM matters at TELCO, which the author found to be relatively higher than that at Canara Bank, in spite of very commendable achievements in the Bank as well.

Summary and Conclusion

On identification of the factors determining QWL in an organization, we have to examine their strengths and weaknesses. The measures for correction and strengthening of these factors naturally may follow. However, management's perception regarding the role of QWL being the core-category, major emphasis should be placed on this category, through remodelling the organization structure and the corporate strategy-emphasis, if necessary and also through greater investment in management development to improve this perception. Similar human resources development and management (HRD and HRM) steps should be undertaken to improve the work-culture and motivation and, if necessary, for improving the participative group activities and job environment measures. Active steps are needed also to modify the intervening variables, as far as possible, and also to strengthen the work-environment and safety system. All these naturally would require a systematic approach for identification of the existing level of QWL in the organization and its improvement.

References

De. Nitish R., Alternative Designs for Work Organisations, New Delhi Sage Publications, 1984.

Delamotte, Y and Walker, K.F., Humanisation of Work and Quality of Working Life, *International Institute of Labour Studies Bulletin*, No. 11, 1974.

Ghosh, Subratesh, Quality of Working Life and Sharing Gains of Higher Productivity, in *Suri, G.K. et al. (eds.)* Quality of Worklife and Productivity, New Delhi, National Productivity Council, 1991.

Ghosh, Subratesh, Quality of Working Life in Two Indian Organisations Implications of case studies, Decision, Vol. 19(2), April-June, 1992.

Maccoby, M., Helping Labour and Management Set up a Quality of Working Life Programme, *Monthly Labour Review*; March, 1984.

Patton, M.Q., Qualitative Evaluation and Research, Newbury Park, Sage Publications, 1990.

Takezawa, S. *et al.*, Improvement of Quality of Working Life in Three Japanese Industries, Geneva, ILO, 1982.

Walton, R., Criteria for Quality of Working Life, in Davis, L.E. et al (eds.), Quality of Working Life, Vol 1, New York, Free Press, 1975.

Appendix 1

Questionnaire 1

Note: For this Research Project, we have adopted a broad concept of Quality of Working Life (QWL) on the basis of the modified adaptation of the criteria and contents of QWL developed by R. Walton, (1975) S. Seashore (1975), Rosow and N.R. De (1984). In the context of Indian organizations, we seek to collect information on the questions posed below, which are expected to assess the current level of QWL in the responding organizations and the scope of improving the same according to the concept adopted by us.

Block I: **Identification**

IA

1. Identification No
2. Name of Organization
3. Address
4. *Sector/Industry to which the organization belongs*:

IB

1. Name of the Responding Office:
2. Designation
3. Department/Division
4. Telephone No. (Office): (Residence):

IC

1. Products manufactured/Services rendered by the organization (mention each item):
2. Total employment of the organisation including all categories of employees permanent/temporary:
   - (i) Managerial Personnel
   - (ii) Non-managerial executives
   - (iii) Supervisors
   - (iv) Direct Workers
   - (v) Indirect Workers (excluding office staff)
   - (vi) Office Staff.
3. Gross Value of output in last 3 accounting years (Rs)
4. Output (in physical or any other objective terms) of each product/service in last 3 accounting years:

Block II: Status of QWL and Methods for Improvement

5. Do you have any existing and ongoing scheme/system/forums for improvement of Quality of Work Life in your organization (encircle the appropriate case)?
   - (a) Quality Circles Yes/No
   - (b) Participative Work-redesign groups Yes/No
   - (c) Forums for Worker's Participation in Decision making (e.g., Joint-labour management committees, Plant Councils, Shop Councils, Joint Productivity Committees, Joint Safety Committees etc.) *If Yes*, mention the type and append a brief note on it/them) Yes/No
   - (d) Productivity gain-sharing plans, e.g., Scanlon Plan, Overall Productivity-base Inventive Schemes, Individual Incentive Schemes etc. (*If Yes*, mention the type and append a brief note) Yes/No
   - (e) Any other Joint-enrichment programme (Excluding items a and b mentioned above) Please mention with a note. Yes/No
6. (a) Do you have any employer-sponsored employee-welfare schemes now in operation? Yes/No
   (b) If yes, please mention them. Yes/No
7. Do you have any arrangement/scheme for employment security of workers? Yes/No
8. (a) Do you have employee benefit schemes in operation in your organization (other than the legally obligatory schemes under any binding law)? Yes/No
   (b) If yes, mention the names of these schemes: Yes/No
9. (a) Do you have any training/development system that exist in your organization? Yes/No
   (b) Do you have any career planning/career development system in operation for your employees? Yes/No
10. (a) Do you have any clearly defined promotion policy?
    (i) For executives Yes/No
    (ii) For other employees Yes/No
    (b) If yes, is the policy formally documented (e.g. in the Standing Order, Service Rule, Official Circular etc.)? Yes/No
11. Do you have the following schemes/systems formally documented?
    - (a) Grievance Procedure Yes/No
    - (b) Disciplinary Procedure Yes/No
    - (c) Recruitment & Selection Policy Yes/No
12. Has there been any collective agreement/settlement signed in your organization during the last six years regulating one or more of the following? (Please tick the appropriate case)

Salary/Wage	Yes/No
Incentives	Yes/No
Promotion Policy	Yes/No
Recruitment Policy	Yes/No
Grievance Procedure	Yes/No
Transfer Policy	Yes/No
Employees benefits	Yes/No

13. Indicate your perception about the existence of the following problems/issues by encircling the appropriate score (4 for Very High, 3 for High, 2 for Medium and 1 for Low)

(i)	Absenteeism	4	3	2	1
(ii)	Indiscipline among employees	4	3	2	1
(iii)	Employees Commitment to organization	4	3	2	1
(iv)	Employees' Job-satisfaction	4	3	2	1
(v)	Accident Rate	4	3	2	1
(vi)	Occupational sickness	4	3	2	1

Arti Nanavati & B.C. Patel are Reader and Statistical Assistant respectively in the Department of Economics, Faculty of Arts, M.S. University of Baroda, Vadodara.

for rise in wages. However, the increased labour cost, which constitutes a significant proportion of working expenses, calls for the need to examine another measure of labour productivity which is output produced per rupee of wages paid. The intent of the paper is therefore to examine these two measures of labour productivity, so as to indicate the nature and extent of distortions in the labour market, because if the factor and product markets work under competitive conditions, both the measures would yield almost the same result and there would be a high correlation between the two.

Table 2: Rate of Growth of Workforce, Wages and Output*

Workforce/ Wages/Output	1970-88	1970-80	1981-88
Workforce			
Group A & B	2.72	2.56	1.63
Group C	2.29	2.28	2.46
Group D	–0.27	0.55	–1.77
Total	0.94	1.31	0.34
Wages			
Group A & B	11.03	9.28	14.01
Group C	12.68	9.59	15.95
Group D	11.22	10.58	13.52
Total	12.03	10.08	15.03
Output	3.09	2.35	4.58

Note: * measured in GTKms

In order to find the extent of demand for different types of labourers, we calculated the elasticity of demand for labour with respect to output and wages (table 3). It can be seen from the table that 1 per cent increase in the output (GTKms) led to 0.26 per cent increase in workforce between 1970-88. The numerical values however was considerably less for the period 1981-88. Among the various groups, the highest value of elasticity of demand was with respect to group C, i.e., 0.52 per cent. However between 1970-80 and 1981-88, for all the groups the elasticity of demand was lower in the later period than in the former. The elasticity of demand with respect to money wages also declined, for the two periods stated above, from 0.119 to 0.022. In order to examine the response of the labour market to real wages, the elasticity of demand with respect to real wages was also calculated. For the period 1970-88, 1 per cent increase in real wages led to 0.7 per cent increase in group A and B workers. In the case of group D, there was a decline with the rise in the real wages. During the two sub-periods 1970-80 and 1881-88, the elasticity was considerably lower in 1981-88 (0.26) for A and B as compared to that in the earlier period (0.59). There was a decline in the other two groups' elasticity also. This shows that in the railways, the short term (1981-88) elasticity of demand for labourers whatever may be the category, is considerably lower than the long term elasticity of demand (1970-88). In the context of structural changes occurring in the railways in particular, it is the short run elasticities which are significant from the point of view of policy formulation.

Table 3: Elasticity of Demand for Workforce With Respect To Output and Wages

Workforce/Wages/ Output	1970-88	1970-80	1981-88
Output			
Group A & B	0.781 (11.22)*	0.679 (4.03)*	0.342 (9.46)*
Group C	0.669 (14.59)*	0.637 (4.58)*	0.518 (9.81)*
Group D	–0.103 (–2.712)*	0.142 (3.50)*	–0.369 (–7.98)*
Total	0.264 (8.33)*	0.358 (4.36)*	0.073 (12.17)*
Money Wages			
Group A & B	0.242 (16.90)*	0.261 (7.96)*	0.116 (16.42)*
Group C	0.186 (26.11)*	0.209 (9.91)*	0.154 (16.94)*
Group D	–0.027 (–2.33)**	0.048 (6.69)*	–0.130 (–14.15)*
Total	0.077 (10.86)*	0.119 (9.68)*	0.022 (9.61)*
Real Wages			
Group A & B	0.711 (7.77)*	0.589 (2.35)*	0.261 (11.09)*
Group C	0.479 (10.99)*	0.496 (3.56)*	0.302 (12.39)*
Group D	–0.097 (–2.71)*	0.114 (3.39)*	0.306 (–9.66)*
Total	0.202 (6.73)*	0.284 (3.66)*	0.047 (9.55)*

Note: * measured in GTKms

In the context of structual changes occurring in the railways in particular, it is the short run elasticities which are significant from the point of view of policy formulation.

Labour Productivity & Implications

In order to aggregate different labour types together into a single measure, we estimated imputed labour, by converting each type of labour to its equivalent in terms of the base year 1970-71 wages of group D workers. The figures are shown in table 4. The labour productivity was found by estimating output (in terms of GTKms) per labour. From the indices one can see that the labour productivity increased by 36 per cent in terms of imputed labour and by 48 per cent in terms of actual labour between 1970-71 and 1988-89. The labour productivity per rupee of wages paid (table 5) was estimated in terms of both money and real wages. Money wages were converted into real wages by using consumer price index with base 1970 = 100. The real wages increased by 3.89 per cent whereas money wages increased by 11.8 per cent.

The labour productivity per rupee of wages paid declined in terms of both money and real wages. However for the former, the fall is quicker. In terms of both the types of wages, the labour productivity declined sharply from 1981 onwards. The coefficient of correlation between the two turned out to be – 0.79.

Table 4: Imputed Labour and Labour Productivity (measure 1)

Years	Labour Productivity			Indices of	
	Imputed Labour	Imputed Labour	Actual Labour	Col. 2	Col. 3
	1	2	3	4	5
1970-71	1962586	192.17	282.07	100.00	100.00
1971-72	1924272	202.83	295.27	105.55	104.68
1972-73	2021565	196.13	288.96	102.06	102.44
1973-74	2056241	176.55	261.12	91.87	92.57
1974-75	2081874	181.83	269.72	94.62	95.62
1975-76	2102871	202.16	300.58	105.20	106.56
1976-77	2124375	213.09	317.17	110.89	112.44
1977-78	2147445	218.49	326.63	113.70	115.8
1978-79	2213063	203.90	305.67	106.10	108.37
1979-80	2256429	200.31	301.74	104.24	106.97
1980-81	2292796	197.77	298.51	102.92	105.83
1981-82	2311780	210.25	318.76	109.41	113.01
1982-83	2324752	216.54	329.14	112.68	116.69
1983-84	2372787	217.82	336.02	113.34	119.13
1984-85	2386729	223.02	346.76	116.05	122.93
1985-86	2424185	239.08	373.90	124.41	132.56
1986-87	2441230	252.41	396.40	131.35	140.53
1987-88	2466327	259.87	411.89	135.23	146.02
1988-89	2484762	261.36	416.65	136.00	147.71

Note: measure 1 = GTKms per labour

The analysis shows that the output per labour increased, whereas per rupee of wages paid declined. This implies that railway workers are paid much more than what they contribute to the output produced by the railways. Thus on the one hand the railways show that they have tried to check the rate of growth of their labour force, but on the other hand they pay their existing workforce so heavily that the labour cost as a proportion of working expenses remains substantial. They are more than compensated for the increase in prices and thus there is no rational link between wages and their productivity. It means that either the railways have to reduce the size of workforce considerably or they should not succumb to the pressure of the labour force, to increase their salaries, just because labour productivity as per measure 1 has increased. In reality it is essential to take labour productivity per rupee of wages paid rather than output per worker into consideration.

Railway workers are paid much more than what they contribute to the output produced by the railways.

Table 5: Real Wages and Labour Productivity (measure 2)

Year	Real Wages	Labour Productivity per rupee of money wages	Labour Productivity per rupee of real wages	Indices of Col. 2	Indices of Col. 3
	1	2	3	4	5
1970-71	4070317	92.66	92.66	100.00	100.00
1971-72	4209105	89.85	92.73	96.97	100.07
1972-73	4093348	87.03	96.86	93.92	104.53
1973-74	3739108	72.24	97.09	77.96	104.78
1974-75	3826728	58.05	98.92	92.65	106.76
1975-76	4596087	54.96	92.49	56.31	99.81
1976-77	3134338	56.09	90.75	60.53	97.94
1977-78	4777642	56.38	98.21	60.85	105.99
1978-79	5008846	50.61	90.09	54.62	97.23
1979-80	5111674	45.86	88.74	49.49	95.96
1980-81	5165647	40.72	87.79	43.94	94.14
1981-82	5044401	39.74	96.37	42.88	104.01
1982-83	5393995	35.72	93.33	38.55	100.72
1983-84	5702631	30.82	90.63	33.26	97.81
1984-85	6156404	27.63	86.46	29.82	93.31
1985-86	6573963	26.45	88.16	28.54	95.14
1986-87	7366557	23.08	83.65	24.91	90.28
1987-88	7667456	21.12	83.58	22.79	90.21
1988-89	8181103	18.78	79.38	20.27	85.67

Note: measure 2 = GTKms per rupee wage

Conclusion

The railways have tried to implement compositional changes in the workforce but have not succeeded in trimming the labourforce. Whatever reduction in number has taken place, has been more than compensated by increase in wages, thus nullifying the structural changes. It is time we emphasized the second measure of labour productivity to formulate the labour policy and manpower planning in the railways, rather than feeling satisfied with the increased output per labour, which is mainly due to modernization and technological changes. □

Deregulation of Public Transport Bus Operations: British Experience

D. Madhu Babu

The legal framework within which the Bus Industry of United Kingdom regulates its operations has been amended during the last decade. It was subjected to massive changes especially by the Transport Acts of 1980 and 1985, which progressively dismantled discriminate regulations from a statute of 1930. The Transport Act, 1985 allowed on-the-road competition between bus services after 50 years of protection through road service licensing. This article examines the status of regulations in Control Bus Industry in United Kingdom since 1980 and also reviews the impact of deregulation during the period of 1985 to 1990 on fares, costs and subsidies, operations, patronage on the bus industry.

D. Madhu Babu is a Faculty Member in Central Institute of Road Transport (CIRT), Pune-411026. He is also the Member Secretary of the Standing Committee on Urban Transport of the Association of State Road Transport Undertakings (ASRTU), New Delhi.

A Public Service Vehicle (PSV) in Great Britain is defined as a motor vehicle, other than a tram, which either: is adapted, and used to carry 9 or more passengers for hire or reward, or is adapted to carry 8 or fewer passengers.

In 1987 there were about 69,500 buses registered in Great Britain as Public Service Vehicles (PSV), out of which 30900 were with 5819 private operators and the rest with Public Sector Operators.

Evolution of Transport Legislation

Some principal changes took place during the last decade: The Transport Act 1978 made limited changes to the licensing system in force since 1930, making it easier for minibuses using volunteer drivers to run stage carriage services (Community buses), and facilitating car sharing. The Transport Act 1980, removed restrictions for express services, made it easier to obtain a licence to operate a stage carriage service in competition with an existing licence holder, effectively removed fares control with effect from April 1981, replaced vehicle licensing with operator licensing. The Transport Act 1983 provided for Public Transport Executives (PTEs) in England to prepare 3 year business plans annually, setting out public transport fares, service levels and subsidy on a common basis. Starting from 1983, it fixed a limit on the permitted expenditure on public transport support which the metropolitan counties and the Greater London Council (GLC) could provide. Support upto this limit could not be legally challenged.

The London Regional Transport Act 1984 transferred responsibility of London Transport from the GLC to the Secretary of State for Transport. London Transport was renamed as a London Regional Transport (LRT) on 1st April 1985. LRT formed a separate company, London Buses Limited (LBL) for its bus operations. LRT put some

loss making routes out to tender and many of these bids were won by other operators from LBL. Following the abolition of the metropolitan counties on 1st April 1986, responsibility of the English Public Transport Executives (PTE) was transferred to Passenger Transport Authorities consisting of councillors nominated by all of the metropolitan districts in each area.

Deregulation of Bus Industry

In 1984, Secretary of State for Transport, presented to the parliament a White Paper on "Buses" which pointed out the need to break away from rising costs, increasing fares and reducing services to enable public transport to win a bigger share of the expanding local transport market. A basic framework of safety regulation and provision for social needs would remain but the introduction of greater competition could stimulate new initiatives and efficiency. The major proposals included in the White Paper were:

- Abolition of Road Service Licensing – the UK regulatory system since 1931.
- Removal of existing exemption of the bus industry from competition law, National Bus Company to be sold to the private sector, Passenger Transport Executive and municipal operations to become "arms length" companies.
- Unremunerative, socially necessary services to be secured by competitive tendering with payments for local authority concessions available to all operators.
- Existing arrangements for quality regulations of safety and orderly operations to be retained.

A basic framework of safety regulation and provision for social needs would remain but the introduction of greater competition could stimulate new initiatives and efficiency.

The proposed legislation followed the privatisation of British Telecom in 1984, but the mainspring for bus deregulation was the general determination of the Government to reduce central and local authority expenditure on public transport which had escalated, particularly as a result of subsidy policies pursued by some of the metropolitan authorities. Across the country, the revenue support grant had risen from 10 million pounds in 1972 to 685 million pounds in 1987, a seventeen fold increase in real terms. To some extent this increase may have originated from a national policy of price restraint in the early seventies, compounded by efforts to provide cheap high quality public transport in major conurbations. The extreme example was South Yorkshire where fares were held at 1972 levels until deregulation in 1986.

In general, fares and subsidies were rising faster than inflation in this period but passenger carrying was decreasing. In the same period, the cost of operating buses increased by 15 to 30 per cent over inflation. Subsidy payments for rural services were modest in comparison with the urban situation. Successive governments attempted to moderate this expenditure without particular success. In comparison with 1953 the modal share for buses decreased from 42 per cent to 8 per cent in 1987 mainly due to the significant rise in private car ownership during this period. (table 2)

Table 1: Transport Statistics, Great Britain (1977-1987)

Group	No. of Operators	Number of Vehicles
National Bus company	56	16400
Scottish Bus Group	11	3400
London Transport	1	5100
Metropolitan Passenger Transport Corporation	7	8600
Municipal Operators	47	5100
Private Operators	5819	30900
Total	5941	69500

Table 2: Transport Statistics in Great Britain (1953-1987)

Mode	1953 Passenger Kms		1977 Passenger Kms.		1987 Passenger Kms.	
	Bns.	%	Bns.	%	Bns.	%
Car	58	30	323	83	451	82
Bus	82	42	51	8	41	8
Rail	39	20	34	7	39	7
Air	0.2	0.1	2	0.6	4	1
Cycle & M.Cycle	17	9	10	1	10	2
Total	196	100	420	100	545	100

In conclusion, the White Paper pointed to a potential for cost reductions of upto 30 per cent based on comparison between NBC operators and PTE/municipal sector together with a study of public and private operators in Australia. The proposed legislation was strongly contested by the bus industry and the metropolitan authorities. The uncertainty regarding the possible effect of competition led to a market reduction in orders and also a significant expansion of minibus operations, pos-

sibly to improve service frequency at minimum cost to meet competition.

The Transport Act 1985, became a law and after a very short preparatory period the initial deregulation measures took effect on 26th October, 1986. It provided for further deregulation of the bus industry. The main provisions of this act are:

- Abolition of road service licensing for local services outside London, any qualified operator can have an unrestricted right to provide bus services on a commercial basis.
- Restriction of subsidy for local services to unprofitable services required to meet social need, subsidy to be awarded only after inviting competitive tenders from different operators.
- National Bus Company to be privatised and local authority bus operations (i.e. municipal operators, including Scottish regional operators, and PTEs) to be formed into separate passenger transport companies operating at 'arm's length' from the local authorities.

The Transport Act 1985 did not apply in London where the LRT Act, 1984 assigned to the newly created London Regional Transport the dual function of owning the operating subsidiaries, London Bus Ltd,(LBL) and London Under Ground (LUG) and being the responsible agency for Planning Public Transport Services within London. In the later role LRT was required to progressively introduce competition for rendering of services, giving no preference to its operating subsidiaries.

Effects of Deregulation

After 5 years of deregulation the initial objectives of subsidy reduction and introduction of competition have been achieved. However the decline in passenger ridership has not been arrested and series of studies indicate that the perceived quality of service has deteriorated. Some specific areas are analyzed in the following paras.

Fares

In metropolitan areas fares rose on an average 23 per cent between 1984 and 1988 though there was virtually no rise in the shire counties and over the whole of England, they rose by 10 per cent. In south Yorkshire fares rose by 22.5 per cent after deregulation. Competing operators had the same fares and coordinated their general fare increases. Routes with higher demand did not have lower fares, as was expected by the Government and also actively competitive routes have different fares from non-competitive routes.

Operations

There was a 15 per cent increase in vehicle kilometers from 1985-86 to 1988. In 1986 before deregulation 80 per cent of the routes were registered as commercial. 1989/90 saw a further 2 per cent increase in kilometers operated, with 83 per cent of services registered as commercial. This increased vehicle kilometers have not been associated with increased use of buses, and the higher fares and instability in bus services have caused bus users to cease travelling, or to divert to other modes. By March 1990 there were 73,000 buses registered of which 18,000 were minibuses. This is about twice the number registered in 1985 when minibuses formed 14 per cent of the total bus fleet. The move of the public sector companies towards minibuses has led to the transfer of redundant full-size vehicles, which has accounted for an increase in full-sized vehicles owned within the private sector. This has led to a significant slump in new registrations of full size vehicles for public service bus operations.

Costs & subsidies

The cost of bus operation outside London excluding provision for depreciation fell by 30 per cent between 1985-86 and 1988-89. According to Stokes (1990) deregulation has been accompanied by a reduction in the cost of running bus services. This can be interpreted as a major success of deregulation. However, most cost reductions have resulted from relative wage reductions for staff, transfer to minibus operations which have lower costs per kilometer and lower staff wages and lower investment in new buses.

Deregulation has been accompanied by a reduction in the cost of running bus services.

The introduction of minibuses has allowed operators to make substantial reductions in maintenance costs. Many bus companies have been able to close and sell off depot facilities, which often realise substantial sums of money for the operator, and to replace them with less sophisticated marketing at suburban sites. In some cases this has made it possible to sub-contract maintenance to the commercial vehicle trade (Gwilliam, 1989). It could be also argued that reductions in wage cost were due to external factors, notably the industrial recession and sub-

sequent high level of unemployment, which made wage rates fall significantly.

While costs of operators have fallen, costs to users have often risen substantially, with higher fares. In the first five years of deregulation, local authority bus support (subsidy) was reduced by about 50 million pounds each year (1.25 billion pounds). The three main areas for support in 1989-90 were:

Cost of tendered services	£ 142.5 million
Concessionary fares	£ 274.0 million
Fuel rebate	£ 150.4 million.

Cost reductions of 97 million prounds were identified, 62 per cent from wage revisions and 38 per cent from improved efficiency. In areas where substantial fare increases occurred, a transfer clearly takes place from bus users to taxpayers. Costs to non-bus users have fallen, because of reduced subsidies. These cost shifts have probably been a major factor in encouraging increasing car ownership.

Patronage

Patronage fell by 5.5 per cent over the country in the first year after deregulation (12 per cent in metropolitan areas). This reduction has continued at around 4 per cent each year (except in London where there has been an increase – 5 per cent in 1988/89). Provincial passenger journeys fell by 13 per cent between 1985/86 and 1989-90. It can be concluded that in terms of the Public Transport System, efficiency seems lower, with more buses running more miles but carrying less passengers.

Market research indicated customer dissatisfaction regarding loss of fares integration, frequent service changes, competing buses operating at the same or similar times, giving rise to actual reduction in frequency and lack of information regarding time and services. Three most frequent complaints were:

- Service less frequent with longer waiting time.
- Inconvenient timing.
- Unreliable services.

The surveys conducted by Stokes (1990) show that most people in the metropolitan areas have coped with the resulting changes; many have experienced them as positive, but the changes have proved very harmful to the urban poor. White and Casidy (1992) argued that given the nature of the bus market, it may not be possible to stimulate effective price and quality competition through deregulation because rather than choosing between different bus services, passengers simply take the first bus.

Given the nature of the bus market, it may not be possible to stimulate effective price and quality competition through deregulation because rather than choosing between different bus services, passengers simply take the first bus.

Manufacturing Industry

Loss of direct subsidy, and uncertainty about the length of contracts won under competitive tenders have made the public and former public sector operators reluctant to invest in expensive new vehicles. Instead, they prefer to extend the lives of existing capital stock or to relay on second hand purchases. Thus, fleet renewal programmes have been severely curtailed with serious effects on chasis and body builders – orders for new standard vehicles fell very sharply around deregulation. Sales of conventional buses have reduced by around 20 per cent on a year-by-year basis since 1985. This has a severe impact on the manufacturing industry leading to large reductions in capacity, with associated costs in staff redundancy enterprises being forced to close down.

The study conducted by Public Transport Executive Group of the Association of Metropolitan Authorities (Stokes et al, 1990) examined the effects of deregulation on the industry and on passengers, and looked at some of the wider effects such as employment, wages costs and patronage. The major conclusions are as follows:

- Deregulation has produced competition in a number of ways but the situation is complex and changing.
- Early competition moved towards mergers, takeovers and consolidation and may now be drifting into oligopoly.
- The bus industry is now more efficient in terms of cost per km. but less efficient in terms of total passengers carried and passengers carried per vehicle km.
- There is a fall in patronage but an increasing market share of concessionary travel.
- The bus industry is now more commercial, some parts are even profitable but the relevance of the regulation versus deregulation arguments is less clear.

- One effect of the legislation on deregulation has been to weaken the scope for using buses as an answer to the urban transport problem.

Conclusion

The principal objectives of the British Government for deregulation were to reduce the level of subsidy and introduce competition – both have been achieved. Some of the major benefits are:

- 13 per cent increase in bus kilometerage
- 400 new private operators (including ex-NBC companies) now provide 66 percent of kilometers operated.
- Substantial reduction in operating costs per bus km through improved productivity.
- New management groups and management styles have emerged. Injection of clear thinking into operational management.

There have been some disadvantages:

- Quantum increase in bus kilometers operated has not produced any aggregate in ridership.
- Fare increases above inflation rate.
- Continued passenger loss which is greater than expected.
- Erosion of integrated travel opportunities and "through" ticketing.
- Significant fall in coordination in respect of time tables, fares and passenger information.
- Virtual elimination of network planning.
- Collapse of the bus manufacturing industry.
- Profit margins of many operators inadequate to sustain long term operation.
- The regulation licensing has been replaced by the regulation of competition administered by the Office of Fair Trading and the Monopolies still vested in the Traffic Commissioners – the bus industry now has three regulatory bodies instead of one.

It is for the authorities to assess the overall impact of deregulation and take the necessary steps to provide the best options to the public.

References

Associations of Metropolitan Authorities, PTEG, Experience, 35 Great Smith Street, London 1990.

A Review of Opinion Surveys. Transport Studies Unit, Oxford University, Oxford, 1990.

Gwilliam, K.M: Contestability, Competitive Practice and Control, Paper presented at an international conference on competition and ownership of But and Coach Services, Thredbo, Australia, 1989.

HMSO: Transport Statistics, Great Britain, 1977-1987 Dept. of Transport, U.K. London.

Stokes G. Pickup, L Meadowcrott, S, Kenny, F, Goodwin, P.: Bus Deregulation: the Metropolitan., 1990

Stokes, G: The effects of the 1985, Transport Act on Passengers Attitudes in Metropolitan Areas., 1990

Stokes, G: The Effects of 1985 Transport Act on Cost and Efficiency of Bus Operations in the Metropolitan Areas, Transport Studies, Unit Oxford University, Oxford, 1990.

White P & Cassidy, S: Local Bus Deregulations and the Consumer, Consumer Policy Review, Consumer's Association London,1992. □

Keiretsu Relationship in Japan – Its Lessons

Jisoo Yu

The Japanese automotive industry has been facing recession in the past few years forcing the auto makers to opt for new strategies to cut costs. This opens up an avenue for foreign suppliers. However capitalizing on the opportunity can be a tough proposition states the author as the quality combined with reliability concept of Japanese Keiretsu relationship may prove to be too difficult to be assimilated.

Jisoo Yu is Research & Planning Officer in the Asian Productivity Organization, 4-14, Akasaka B Chome, Minato-Ku, Tokyo 107.

The recession presently sweeping Japan began to be felt when the Bank of Japan, under the guidance of the Ministry of Finance, exercised control on currency in the late 1980s in an attempt to hold down the skyrocketing real estate prices. Thanks to that policy, real estate prices nosedived. The collapse of the real estate and stock markets, however, had a seismic impact on financial institutions that had made huge investments in property. The monetary squeeze also stifled domestic demand. Overoptimistic economic forecast had been the basis of capacity expansion drives in Japanese industry during the previous few years, which made the situation worse.

The Japanese economy has been pulled by two locomotives: auto and consumer electronics industries. Massive employment has been created by these two industries; the auto industry alone absorbs some 6.5 million people, or 10% of the total work force, in Japan. Although the future of Japanese economy will be determined in large part by the performance of the auto industry, its prospects are not bright. Sales continue to slide; in 1992 they plunged by 7.2 per cent. For the first time in 11 years, sales decline was recorded in two consecutive years.

At the same time, overseas competition has become more intense. US auto makers have streamlined their operations and made remarkable improvement in quality and productivity. The intensified competition will force Japanese auto industry to shave its razor-thin profit even further. Currently Japanese auto makers barely make a profit of US$100, on average, on each new car sold in Japan. Thus a sizable number of layoffs will become inevitable if the economic slump continues. In particular, the small and medium-sized companies will suffer most.

Structure of Keiretsu

In reports published abroad, the term *keiretsu* has been used comprehensively to include all suppliers that

have a business relationship with a major company. In Japan, however, suppliers are usually classified into three groups: *keiretsu*, business collaborators and independent suppliers. Due to lack of clear definitions of these terms, precise classification of vendors is difficult. For example, Asian Industry, an auto parts manufacturer, is classified as a Toyota *keiretsu* by some people, but as a Toyota business collaborator by others. Although the demarcation among various types of vendors may not be clear, *keiretsu* companies are characterized by the fact that they are partly owned by a parent company from which approval must be granted for important management decisions. Board members in some *keiretsu* companies are designated by the parent companies.

Keiretsu companies are characterized by the fact that they are partly owned by a parent company from which approval must be granted for important management decisions.

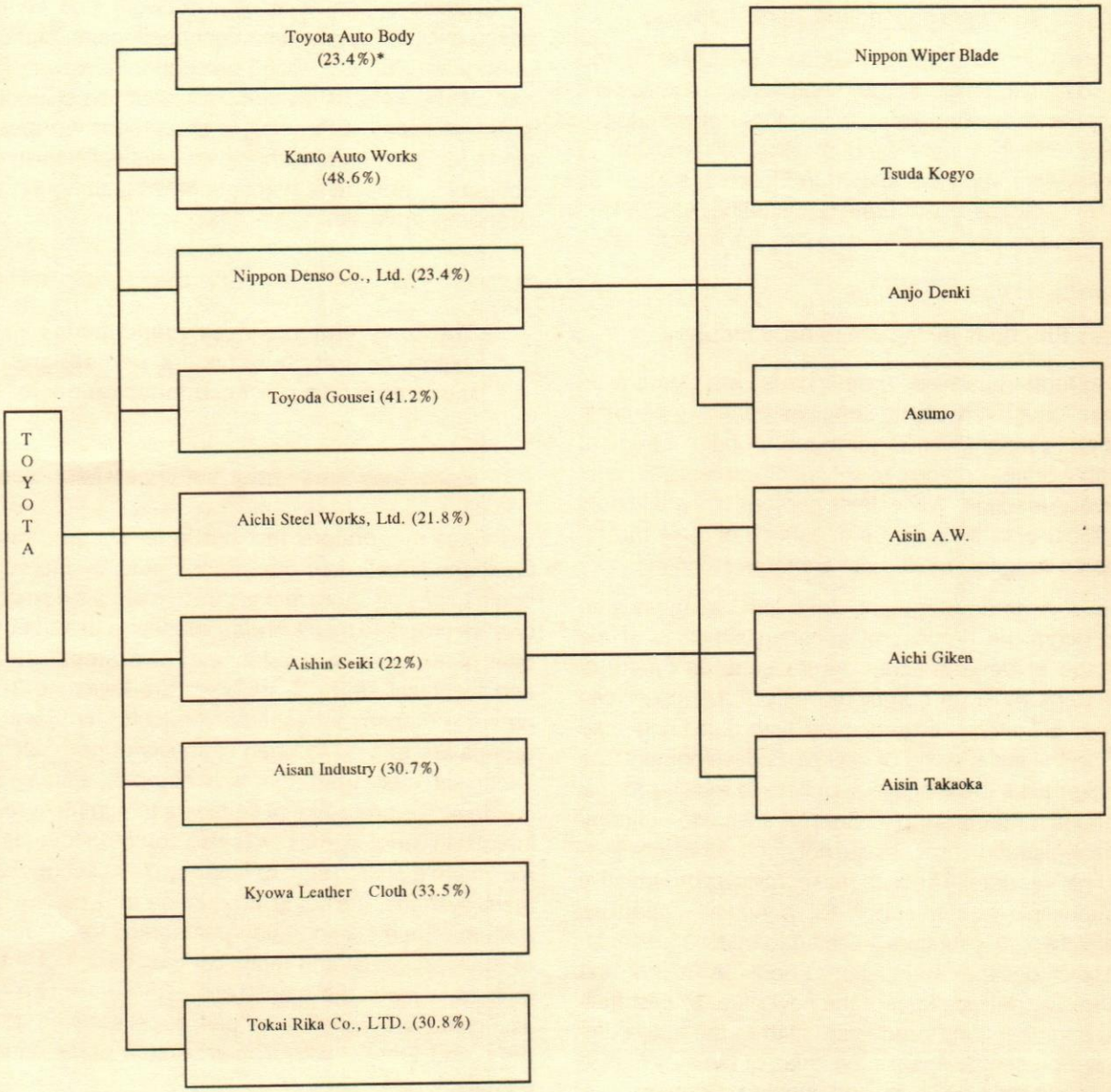

Fig. 1 Selected Major *Keiretsu* Vendors of Toyota
(*) The equity percentage owned by Toyota

Business collaborators and independent suppliers can be differentiated from *keiretsu* companies on the basis of three elements: management autonomy—dependence on the parent company in terms of sales volume and ownership. Business collaborators have more freedom than *keiretsu* companies. However, since the major customer of business collaborators is the parent company, they refrain from making any decisions that may annoy the latter. Independent suppliers are less dependent in terms of sales volume on the *keiretsu* parent company than business collaborators are, and thus are free to make autonomous management decisions. In general, the major auto makers do not invest in their business collaborators and independent suppliers.

Figure 1 shows the major vendors positioned in top tiers of Toyota *keiretsu*. Supporting these companies is a vast number of smaller *keiretsu* vendors not included in the figure, which supply various parts. In addition to Toyota *keiretsu* suppliers shown in Figure 1, it also has some 16 business collaborators including Araco Co., Hutaba Sangyo, Koito Seisakusho Co., Siroki Kohyo Co., etc.

Business Practices in Japanese Auto Industry

Long-term business partnerships are sought in Japanese industry. Foreign suppliers generally perceive that their responsibilities are to: supply parts at reasonable prices conform to set specifications and meet the delivery deadline. While these perceptions would hold true in most countries, in the Japanese context the requirements suppliers must meet are more stringent.

In new parts development, the major Japanese auto makers begin the process of securing suppliers at the early stage of development. As indicated in Figure 2, several steps must be completed before a supplier can enter into a *keiretsu* arrangement with a leading auto maker. In the initial stage of new parts development, the auto maker asks prospective suppliers to register formal applications for parts supply. Suppliers who do not complete the registration process are not considered in selecting the final vendors. The auto maker reviews prospective part suppliers with respect to potential capability. Generally, two suppliers are selected to make a presentation that includes their suggestions about the function and the technical specifications of the new part. In this briefing, the engineers and production staff of the auto companies are present to assess the ideas of the suppliers in terms of economic feasibility and supplier capability.

The final selection of one or two suppliers is based not only on their costs, quality and production capability, but also on their technical expertise in advising the auto maker on the function, reliability, standardization and production efficiency of the new part. If the final evaluation is favourable, a prototype is ordered, for which the auto maker usually pays. If the prototype indicates that mass production is feasible, the auto maker holds a discussion with the suppliers to determine a pilot production schedule. The suppliers are expected to improve the part through redesign throughout all the stages of the production process, thus demonstrating their capability. This requirement places considerable pressure on the supplier companies' resources.

Outside Japan, it is often thought that *keiretsu* is based exclusively on human connections and continuing patronage. This is a wrong perception however. To be a part of the *keiretsu* system, suppliers must undergo a series of tests. If they fail to pass them, no mercy extended. The long-term business relationships in Japan, contrary to outsiders' perceptions, thus thrive on a strict economic rationale.

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Once the tortuous test period is over and the client company is satisfied, the efforts made by the suppliers begin to pay off. Auto makers try to maintain a steady flow of work orders to their *keiretsu* suppliers. In addition, they offer other types of assistance. For example, engineers and technical staff of suppliers are invited to join the parent company's research projects, or joint study groups are formed to open channels of communication. Technical staff from the two companies may attend academic or professional seminars to stimulate research interest in various areas. It is also common for major auto makers to dispatch staff to help suppliers set up management systems, including production and quality control system. Such collaboration contributes to enhancement of the managerial and technical capabilities of the parts makers. Under the giant Toyota there are two vendor associations: Kyohokai for part suppliers with 234 vendors; and Eihokai with a membership of 77 equipment manufacturers.

To many foreign suppliers who are considering forging business partnerships with Japanese auto makers, the

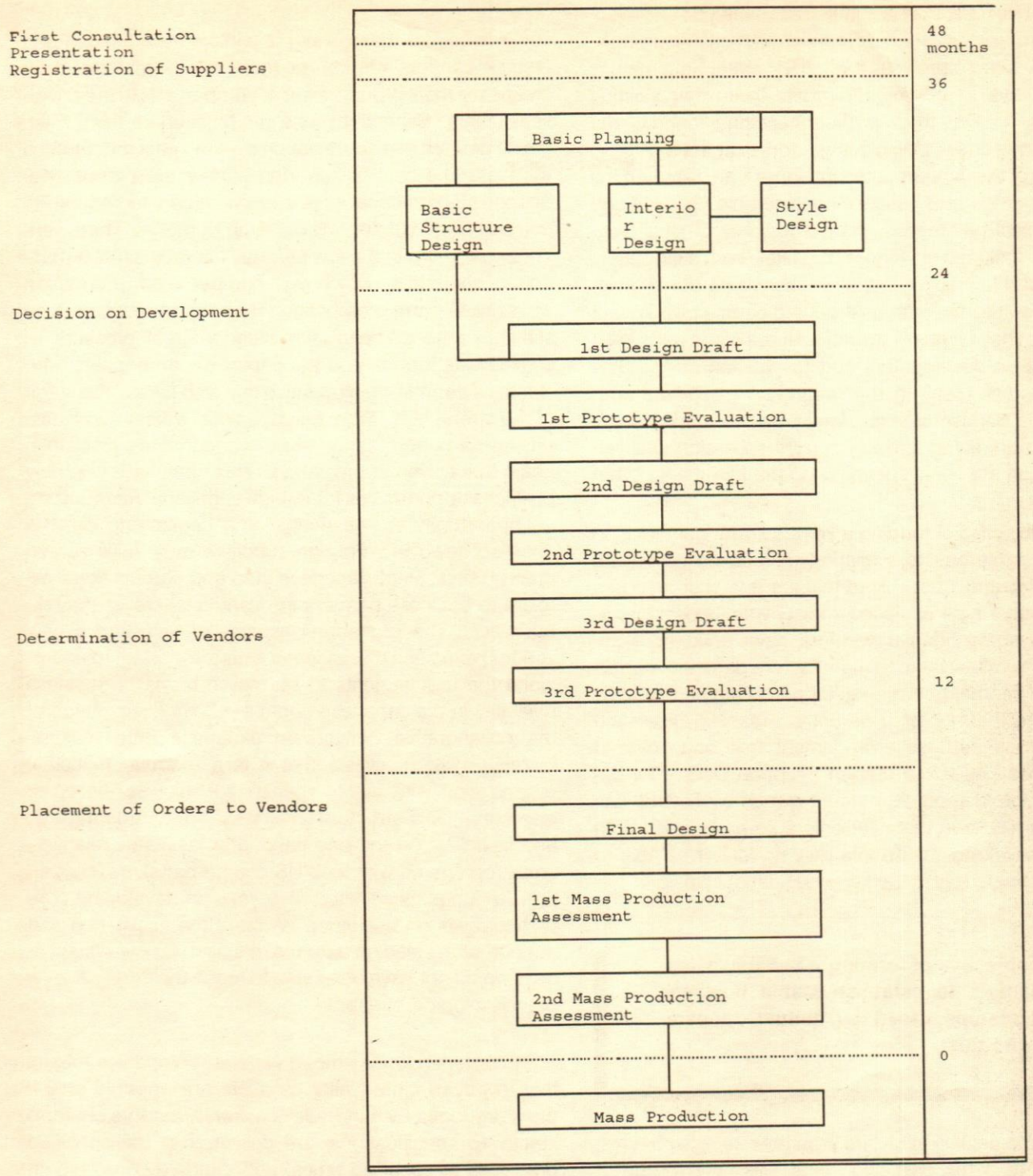

Fig. 2 Role of Suppliers in Developing New Cars

long and demanding process of acceptance may appear unappealing. There is no other choice, however, but to conform with the Japanese practice in doing business with Japanese auto makers.

Changes in *Keiretsu*

During the oil crises in 1970s, Japan launched an export drive as a measure to overcome recession. In 1985, to cope with the surge in the value of the yen

resulting from the Plaza Accord, businesses cut the salaries of top executives, eliminated waste and inefficiency, and froze recruitment of new employees. Currently, the plunge in auto profits is forcing the major auto makers to seek ways to eke higher profits from their existing operations. On their profit-enhancing agenda, the elimination of small, inefficient vendors is at the top of the list. Most of the vendors listed in Figure 1 are listed on the stock exchange and possess considerable financial and technological resources. Yet the majority of small vendors, not included in Figure 1, suffer from inadequate facilities and low efficiency, and they will be the first victims of the auto makers' cost-cutting campaign. Toyota and Nissan have already agreed to share some parts in an effort to save development and production costs. The agreement will result in the redundancy of some suppliers. The demise of small, family-owned vendors has long been predicted and the current recession and yen appreciation are only speeding up the fulfillment of that prediction.

The objective of forming a *keiretsu* arrangement is to establish stable business relationships based on mutual cooperation and trust. Auto-makers and their vendors have formed a type of closed society with its own hierarchy. Yet some first-tier vendors have acquired technologies that allow them to manufacture parts that can be sold in the international market for prices higher than they can charge their *keiretsu* parent companies. For such suppliers, the *keiretsu* arrangement that once offered prestige has become a burden. Nippon Denso, for example, which is about 20 percent owned by Toyota, has become a leader in the electronic auto parts field. With this new development, Toyota may no longer be able to play a dominant role in the *keiretsu* relationship.

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Facing a decline in orders from their *keiretsu* buyers, especially over the past two years, this new group of vendors has increased pressure on the leading keiretsu companies for more autonomy in such areas as negotiation with outside buyers; expanding their overseas investment; and diversifying their business. If the current economic slump is prolonged, it will further weaken the position of the leading auto makers vis-a-vis the keiretsu vendors armed with leading-edge technologies.

New Opportunities & Challenges in Collaboration

It is certain that the big Japanese auto makers and first-tier vendors will import more foreign parts and increase the local procurement of components in their overseas plants. Several reasons can be cited for this . First, the 20 percent yen appreciation over the past four months will make the cost of imported parts more competitive. Second, international pressure on Japan to reduce its massive trade surplus will continue to mount. Third, vendors positioned in the low *keiretsu* tier face serious manpower shortages, which will hamper their production capacity. Fourth, competition in the auto industry is so stiff that auto companies are under great pressure to shave costs further, and the import of components constitutes a compelling alternative that also takes advantage of the strong yen. Fifth, for Japanese overseas affiliates, buying parts from Japan is not economically justifiable, again due to yen appreciation. This could open up new business opportunities for foreign suppliers. Recognizing an opportunity is one thing, and capitalizing on it is another, however. Foreign suppliers must fulfill certain prerequisites, since Japanese auto and parts makers will relate to business partners in fashion wherever they do business. The procedural aspects of selecting a new vendor have been discussed; it is also important to understand the requirements to be met in terms of business reliability in the Japanese context. Close examination of the collaborative network in Japanese auto makers' *keiretsu* system reveals that it is a modular industrial organization with highly specialized units as the basic elements. This structure allows for agility, adaptability, and flexibility, on the one hand, and facilitates relatively small (compared with their US counterparts), specialized firms to focus their limited resources on developing core technologies on the other. Without the assistance and support of the leading auto makers, first-tier *keiretsu* vendors would not have been able to reach their current level of technological capability.

Interdependence among *keiretsu* companies means that low-cost, high-quality products are possible only if parts produced by hundreds of *keiretsu* vendors conform strictly to specifications, are delivered in the specified quantities at specified times, and improve constantly in terms of function, cost, and quality. Even a minuscule breakdown in this complex chain of collaboration can have devastating effects on the total performance. The reliability of participants, which means more than simply producing quality parts, thus has paramount importance in the *keiretsu* system. Reliability forms the philosophy and cultural norm of Japanese *keiretsu* relationships.

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The virtues of patience, moderation, humility, and industriousness are emphasized throughout the entire Japanese education process. The social culture founded on these virtues translates easily into the desired corporate culture emphasizing loyalty, groupism, cohesiveness, quality-consciousness, and reliability. Such a culture glues modular business units into powerful *keiretsu* networks. It is a challenge for non-*keiretsu*, foreign vendors accustomed to different milieus to adapt to a new business setting.

Foreign suppliers often have the misconception that they can meet Japanese requirements for quality as long as they replace their defective parts with new ones. This business practice, however, will not be accepted by Japanese partners. The renowned Japanese productivity standards stem from the just-in-time-based production system, which maintains minimal inventory levels. Therefore, even a small number of defective parts may cause the production line to stop. Japanese also believe that quality can be improved when the production process is stabilized. Process disruptions caused by non-conformed parts, therefore, will not be tolerated.

The creation of quality-and reliability-centered culture can not be achieved by merely installing statistical quality control systems. The participation and commitment of workers are essential to produce and deliver the right amount of quality parts by the specified time. Instilling a new culture into an organization requires the commitment of the top management and intensive training of employees. It is a long, slow, uncertain process, particularly for potential vendors from countries where reliability in the Japanese context is not emphasized. Without deliberate efforts to create that type of reliability-based culture, however, attempts to forge new business relationships with Japanese auto firms will be risky. □

Identity Crisis

A Japanese salary man goes through a stage of identity crisis: when he reads Druckers's books, he identifies himself with management, but when he asks for pay raises, he identifies himself with the union.

— Masaaki Imai

Productivity Gap in a Hybrid Cotton Seed Enterprise

T.R. Shanmugam & V. Thirupathi

There exists a wide gap between the demonstration and actual farm yield in hybrid cotton seed production. Labour use, agricultural chemicals and plant nutrients are the significant technical factors in exploiting the potential farm productivity. Long term socio economic variables like intensification of extension education and liberal credit policy are recommended for bridging the yield gap in hybrid seed enterprises. Seed production and management practices like spacing and type of soil are other crucial agronomic factors which can minimise the yield gap, conclude the authors.

T.R. Shanmugam is an Assistant Professor & V. Thirupathi is a Senior Research Fellow, in the Department of Agricultural Economics, Tamil Nadu Agricultural University, Coimbatore - 641003

Agricultural productivity relies heavily on seeds of high yielding varieties for all crops. Varieties with high genetic potentials when adequately supported by a complement package of other inputs and services, have demonstrated their contribution for output expansion. Commercial production and distribution of cotton seeds gained currency in India in the mid-seventies with the introduction of hybrids whose yields surpassed the traditional varieties by two folds and more. Spontaneously came the response of enterprising farmers to take up hybrid seed production though with corrections and modifications appropriate to the local condition.

Hybrid cotton seed production is recognised as a highly specialised enterprise involving some unique practices which are completely different from that of growing cotton for commercial purpose. Getting parent seeds with high genetic and physical qualities, maintaining isolation distance, rouging, emasculation, crossing, getting field inspection by seed certification agency, ginning, cleaning, chemical treatment and bagging of seeds are the sequence of practices needing meticulous care throughout. Although, a capital intensive enterprise, biological and socio-economic factors play a vital role in decision making for maximum return. However, there exists a large gap between potential farm yield and actual farm productivity of hybrid cotton seeds. An approach is attempted in the present study to identify and regress the constraints responsible for the yield gap.

Data & Methodology

The study was undertaken in Sathyamangalam taluk of Periyar District in Tamil Nadu because of the high concentration of hybrid cotton seed production in this taluk. The study was based on the data from 80 randomly selected farmers producing hybrid cotton seeds in the taluk. About 20 demonstration plots maintained by

private seed agencies were selected randomly. The data related to the crop year 1991-92. The sample farms' data and relevant demonstration data were collected by personal interview.

Yield gap has been defined as the quantitative difference between the actual yield and potential yield (Widawsky & John C. O'Toole, 1990). The yield gap can be divided into two parts (Gomez, 1977). Yield gap 1 is the difference between an experiment station's maximum yield and on-farm experiment's maximum yield. This gap arises from differences in environment which cannot be managed in farms. Yield gap 2 was the primary concern of the study because it is the difference between actual farm yield and productivity attained in on-farm experiments or demonstration plots. This gap reflects technical and socio-economic constraints. The input gap was obtained by deducting the amount of input used at the farmers' field from the amount of the respective input, used at the demonstration plots. For identifying the influence technical and socio-economic constraints on yield gap, a Cobb-Douglas type production function was used. The ratio of the actual farm yield to the demonstration plot yield was considered as the dependent variable and the set of technical and socio-economic constraints prevailed in the actual farming situation were included as explanatory variables.

The specified mode is give as:

$$\ln \hat{Y} = \ln A + \sum_{i=1}^{11} b_i \ln x_i + U_i$$

where

Y = Ratio of the actual yield to demonstration yield (per ac)

X_1 = Expenditure on parent seeds in the farmer's field (Rs. /ac)

X_2 = Expenditure on fertilizers (Rs. /ac)

X_3 = Expenditure on plant protection chemicals (Rs. /ac)

X_4 = Expenditure on irrigation (Rs. /ac)

X_5 = Expenditure on labour (Rs. /ac)

X_6 = Expenditure on crossing covers and bags (Rs. /ac)

X_7 = Education of the respondents (years of schooling)

X_8 = Farming experience of the respondents (years)

X_9 = Soil type dummy, 2.718 for black solid and one otherwise

X_{10} = Credit access dummy, 2.718 for easy access to credit and one otherwise

X_{11} = Spacing dummy, 2.718 for right spacing and one otherwise

When log transformed, the values 2.718 and one became one and zero respectively.

Results

The data presented in table 1 reveals the fact that the productivity of hybrid cotton seed was much below the potential yield at the demonstration plots. The difference was 191.59 kgs per acre and it was significant. The yield gap of 32 percent indicated the possibility of increasing the seed productivity at the farms by one-third of the present level if the best technology could be adopted by the farms. The yield gap was attributed to sub-optimal input use and lower resource productivity. The size of input gap was found to be higher for human labour and plant protection chemicals. This confirmed the fact that the yield gap was basically attributable to sub-optimal use of labour and plant protection chemicals.

Table 1: Yield and input gaps in cotton seed production

	Particulars	Demonstration Plots (n = 20)	Farms (n = 80)	Gap
I.	Seed Yield (Kg/ac)	598.17	406.58	191.59 (32.03)
II.	Inputs (Rs./ac)			
1.	Human Labour	7841.39	6385.14	1456.25 (18.57)
2.	Parent Seeds	826.83	789.73	37.10 (4.49)
3.	Fertilizers	2193.48	1768.42	425.06 (19.38)
4.	Plant Protection Chemicals	3846.72	2435.79	1410.93 (36.68)
5.	Irrigation	896.36	812.56	83.80 (9.35)
6.	Bullock Labour	687.51	669.34	18.17 (2.64)
7.	Crossing Covers	1692.63	1204.65	487.98 (28.82)
8.	Seed Bags	986.21	807.43	178.78 (18.13)
	Total Input Cost	18971.13	14873.06	4087.07 (21.60)

Figures in parentheses are percentage gaps.

In the absence of socio-economic constraints, we would be identifying a portion of the total yield gap. If the yield gap was wholly accounted for technical constraints, then it would indicate a problem, with the underlying

theory and the measurement procedure. Hence the influence of socio-economic factors on the yield gap was considered in the study. The estimated yield gap regression is presented in table. 2. The significant coefficient of multiple determination implies that more than 72 per cent of variation in the realised demonstration yield was explained by the variations in the independent variables incorporated in the model.

Table 2: Estimates of yield gap function

Particulars	Coefficients
Parent Seeds	0.0048 (0.7329)
Fertilizers	-0.0069* (2.1478)
Plant Protection Chemicals	0.0283* (2.5691)
Irrigation	0.0051 (1.2843)
Labour	0.0346* (1.9752)
Covers and Bags	0.0043* (1.8496)
Education	0.0215* (1.7934)
Farming Experience	- 0.0146 (0.8357)
Soil Type	0.0375* (1.7492)
Credit Access	0.0294* (2.3754)
Spacing	0.0418* (2.0873)
R^2	0.73
Adjusted R^2	0.71
Number of Observations	80

* Significant at 5 per cent level
(Figures in parentheses are t ratios)

The yield gap was attributed to sub-optimal input use and lower resource productivity.

Technical Constraints

The regression results reveal that fertilizer, plant protection chemicals, labour and crossing covers and bags had significant influence on the realised demonstration yield. It implies that these inputs could be applied at higher doses for exploiting untapped potential demonstration yield. Majority of the farmers in the study area felt that they were already using enough quantities of these inputs. But, we found that those inputs were applied untimely, indiscriminately and in an imbalanced manner. Some farms, had no adequate means of acquiring the required inputs. There are farms faced with the problem of high cost and shortage of inputs. In such a context, a liberal credit policy and a scheme for timely supply of agricultural chemicals would solve problems. Majority of the farms ranked the acute labour shortage during the peak season as the most important constraint. It was noticed that labour supply could not meet the demand during crossing period and acted as a barrier to the exploitation of available technology.

A liberal credit policy and a scheme for timely supply of agricultural chemicals would solve problems.

The significant coefficient for the soil type confirmed the fact that black cotton soil is most suitable for seed production. In the study area, about 70 per cent of farms produced seeds on black cotton soil. The environmental conditions of the study area was found to be extremely conducive for seed production.

Delimiting such areas as seed production zones would obviate the difficulties involved in maintaining isolation distance and other technical problems. Under these circumstances, economies of scale would operate benefiting the seed producer. Adoption of recommended agronomic practices was found to bridge the yield gap. Certain practices like spacing would produce a noticeable fall in output. This fact was confirmed by the estimated coefficient for spacing. It implied that yield gap was dependent not only on the level of inputs like fertilizers and pesticides but also on the cultural practice i.e. spacing.

Socio-economic Constraints

Education and credit access were the two important socio-economic factors which significantly bridged the yield gap. This fact strengthens the earlier view that a liberal credit policy would help the farms in availing technology and there by reducing the gap. Education could contribute to bridge the yield gap by better exposure to extension techniques and by successful adoption of improved technologies. The experience of the respondents was found to exert a negative but nonsignificant influence on the yield gap. This emphasised the view that educa-

tion coupled with training in hybrid seed production would help them in exploiting the new technology rather than mere experience.

Education and credit access were the two important socio-economic factors which significantly bridged the yield gap.

Conclusion

The analysis revealed that there existed a wide gap between the demonstration and actual farm yield. The availability of agricultural chemicals and nutrients in proper time and labour supply during peak seasons were found to be the most important technical constraints in hybrid seed production. Better exposure of the farms to new technology through education and liberal credit policy would help in the long run minimising the yield gap in yield seed production.

References

Gomez, K.A. (1977). "On Farm Assessment of Yield Constraints: Methodology Problems", Constraints to High Yields on Asian Rice Farms: An interim Report, International Rice Research Institute, Los Banos, Philippines.

Widawsky, D.A. & J.C. O'Toole (1990). Prioritizing the Rice Bio-technology Research Agenda for Eastern India, The Rockefellar Foundation, New York. □

The Acid Test

Howsoever a management is knowledgeable, its ultimate test is business performance. Achievement rather than knowledge remains, of necessity, both proof and aim of management.

— Peter F. Drucker

Management must keep the enterprise successful and profitable in the present or else there will be no enterprise left to enjoy the future.

— Peter F. Drucker

Towards Commercialisation of Agriculture in Tumkur District

S. Erappa & Jayasheela

Commercialisation of agriculture in Tumkur district has been observed while studying the cropping pattern during 1980s. The data reveal that the area and productivity of commercial crops are increasing making in-roads into food crops. This is due to the government's policy of controlling the prices of food crops through its price policy and the public distribution system, states this article.

S. Erappa & Jayasheela are from the ADRT Unit, Institute for Social and Economic Change, Bangalore 560072.

Commercialisation of agriculture can be studied in two ways: one way is to find out the area under different crops, particularly the shift towards commercial crops. The other is to examine the market situation of different crops. In India where agriculture is a controlled variable for economic development, it does not make sense to delve into the marketability of crops. Here we look into the shifts in cropping pattern (to be specific, in one district, Tamkur in Karnataka) towards commercialisation.

A Brief Profile of the District

The geographical area of Tumkur district is 10.65 lakh hectares, of which land not available for cultivation and total cultivable land account for 1.93 and 8.72 lakh hectares respectively. As per the 1991 census, the population of the district was 23.01 lakhs and the actual rainfall (provisional) recorded during 1990 was 550 mm (688 mm normal rainfall), as against the State average of 1,062 mm (1,139 mm normal rainfall). The rainy days were a little higher in Tumkur district (38) as compared to Raichur (33), but considerably lower than the State average of 55 rainy days during 1989 (Directorate of Economics and Statistics, 1990). The number of inhabited and uninhabited villages accounted for 2,506 and 221 respectively in the district. The district contributed Rs. 648 crores of income to the total of Rs. 16,447 crores of the State during 1988-89 (Directorate of Economics and Statistics, 1990-91).

The literacy rate during 1989-90 seems to be a little less (37 per cent) in the district (Male 48 per cent and Female 28 per cent) as against the State average of 38 per cent (Male 49 per cent and Female 28 per cent). The banking sector, namely, commercial bank branches (128) and Gramin Bank branches (50) functioning in the district during 1990-91 (Directorate of Economics and Statistics, 1990-91) mobilised Rs. 205 crores and disbursed loans to

the extent of Rs. 146 crores. The credit deposit ratio, however, seems to be less (71 per cent) as compared to the State average (86 per cent).

Credit co-operative banks, PLD banks and non-credit co-operative societies also advanced financial assistance to the concerned category of beneficiaries for the overall development of the district. The number of co-operative milk societies has increased from 12,786 in 1977-88 to 33,966 in 1983-84 in the district (Karnataka Co-operative Milk Producers' Federation, 1989).

The percentage of rural and urban population accounted for 86.2 and 13.2 respectively in Tumkur district, as against the State average of 71.1 and 28.9. The density of population per sq. km in the district was 187, which is a little less than the State figure of 194. The decennial growth rate of population has increased from +10 in 1901-1911 to +21.5 in 1971-81 in the district, as against +3.6 and +26.8, respectively in the State. As per the 1981 census, the main workers and marginal workers accounted for 89.7 per cent and 10.3 per cent respectively in rural Karnataka. Among the main workers, cultivators constitute 43 per cent and then follow agricultural labourers, (29 per cent). That means about 72 per cent of the rural population still depends on agriculture.

The composition of workers in Tumkur district (both main workers 36.2 per cent and marginal workers 5.2 per cent) and non-workers (58.6 per cent) more or less tallies with the State average.

Objectives of the Study

The main objective of the study is to examine the behaviour in terms of area, production and productivity of a few dry crops like ragi, groundnut, coconut and mulberry in the district over a period of time; and further, to analyse the percentage of land owned by farmers with respect to their land size; the predominant crops grown in the drought district like Tumkur; and finally, the reasons for the decline in the area, yield etc., and details of the crops encroaching upon the land.

Data Base

This study is based on secondary data published by the Department of Agriculture, Directorate of Economic and Statistics, Department of Sericulture, Government of Karnataka and Agriculture Census Report and Census of India. The reference years covered for this paper are from 1981-82 to 1989-90. This period has been grouped into two (1981-85 and 1985-89) to even out the fluctuations in some years and the average of the four years has been considered for this study.

Results of Analysis

Table 1 furnishes the details of agricultural land holdings across different groups of farmers, both at state and district level, related to the number and area during 1985-86. While 63 per cent of the marginal and small farmers are oning 23 per cent of the area in the state, 73 per cent of the same category of farmers are cultivating 33 per cent of the land in Tumkur district. It is interesting to note here that 20 per cent and 15 per cent of the land was under the control of 3 per cent of the farmers respectively, in Karnataka and in Tumkur district.

Table 1: Percentage distribution of Area and Number of Agriculture Landholding in 1985-86

Size class of holding	No. of holdings		Area	
	Karnataka	Tumkur	Karnataka	Tumkur
Marginal	37	47	7	12
Small	26	26	16	21
Medium	34	25	57	52
Large	3	2	20	15
Percentage	100	100	100	100
Actuals	4919	369	11879	677

Source: Agriculture Census 1985-86

The extent of major crops grown during 1988-89 is presented in table 2. Jowar occupies the highest place in terms of cropped area and then follow paddy, ragi,

Table 2: Area under selected crops grown during 1988-89
(in percentage)

Crops	Area	
	Karnataka	Tumkur
Paddy	11.86	6.44
Ragi	11.70	31.89
Jowar	23.48	2.60
Other Cereals*	12.18	4.36
Other Pulses#	16.37	12.60
Groundnut	11.89	30.13
Cash crops $	9.04	0.35
Coconut	2.22	9.24
Mulberry	1.15	1.39
Percentage	100.00	100.00
Actuals (in lakh hect.)	99.87	5.74

Note: * Other Cereals include bajra and wheat
Other Pulses include gram and tur
$ Cash crops include sugarcane and cotton.
Source: Karnataka at a Glance, 1989-90

groundnut, and other pulses in Karnataka during the reference period, whereas, in Tumkur district 60 per cent of the area was dominated by crops like ragi (31.89 per cent) and groundnut (30.13 per cent) in the above mentioned year. The next important crops grown were coconut (9.24 per cent) and other pulses (11.86 per cent).

We intend to examine the fluctuations in area, production and average yield of major crops like ragi, groundnut, coconut and mulberry in Tumkur district. Since this study does not have primary insights, notional attributes discussion with the officials concerned are furnished. A careful perusal of table 3 brings out the fluctuations related to area, production and yield per hectare of ragi crop which does not show significant progress in terms of production and productivity, but shows a consistent negative trend over a period of time. Between 1981-82 and 1989-90 the total production declined by 6 per cent and 9 per cent for both Karnataka and Tumkur, respectively. This could be attributed to the lack of interest of farmers in cultivating food crops for which the productivity and prices are low due to government intervention. The trend that emerges from this is that farmers are induced towards cash crops rather than towards cereals.

Farmers are induced towards cash crops rather than towards cereals.

Table 3: Area, Production and Average Yield of Ragi Crop (All Varieties and Seasons)

(Annual Growth Rates)

Year	Area		Production		Average Yield	
	Karnataka	Tumkur	Karnataka	Tumkur	Karnataka	Tumkur
1982-83	8.60	5.73	- 32.90	26.85	- 24.97	- 12.56
1983-84	- 2.06	- 1.51	55.36	- 12.04	41.81	- 4.82
1984-85	- 3.86	- 2.29	- 18.52	- 8.47	- 19.61	- 6.28
1985-86	2.59	- 2.00	- 5.95	1.33	3.35	0.65
1986-87	5.92	14.90	29.53	- 34.76	- 22.34	17.28
1987-88	- 5.00	- 1.98	- 21.49	13.17	17.35	11.44
1988-89	3.07	4.97	- 5.25	5.90	- 8.14	- 10.23
1989-90	1.47	- 2.33	22.45	33.85	20.73	- 36.83
%age increase (1981-82 to 1989-90)	1.65	8.90	- 5.75	9.08	- 7.27	0.17

Note: Area in hectares, Production in tonnes, Average yield kgs/per hectare.

Source: Annual Season & Crop Reports, Directorate of Economics and Statistics, Government of Karnataka, Bangalore.

The area under groundnut crop is increasing gradually in Karnataka, whereas in Tumkur district the annual growth rate has been increasing at a much faster rate over a period of time. From 1981-82 to 1989-90 it has recorded a rapid increase in area (102 per cent) in Tumkur district (Table 4). This gives the clue that groundnut crop is encroaching upon the area of other crops like ragi. Similar to the area increase, the production also shows positive trends at the State level and also at the district level. But the productivity gives mixed trends annually over a period of time and the increase seems to be marginal.

Table 4: Area, Production and Yield of Groundnut crop in Karnataka and Tumkur District

(Annual Growth Rate)

Year	Area		Production		Average Yield	
	Karnataka	Tumkur	Karnataka	Tumkur	Karnataka	Tumkur
1982-83	- 1.10	- 4.62	- 15.96	- 34.76	- 14.03	- 31.60
1983-84	2.81	10.31	31.25	75.57	27.75	59.15
1984-85	15.57	15.37	29.86	- 26.11	12.32	- 35.94
1985-86	0.31	- 3.82	- 26.77	11.24	- 26.99	- 15.51
1986-87	2.11	17.04	6.96	31.37	4.82	12.32
1987-88	2.17	13.29	24.19	53.50	21.49	35.62
1988-89	21.31	19.61	8.55	1.15	- 10.57	15.46
1989-90	- 6.78	8.87	- 4.74	- 7.84	2.24	- 15.36
%age increase (1981-82 to 1989-90)	39.05	101.75	45.82	76.98	4.85	- 12.28

Source: Same as Table-3.

The same trend can also be noticed in the case of coconut (table 5). The area under coconut crop has increased by 19.37 per cent over a period of nine years in Tumkur district and the yield per hectare has kept the same pace. Further, it reveals that farmers take the decision of accepting a particular crop on the basis of its productivity.

The yield rate has declined for coconut in some years since 1984-85 onwards. This does not affect the positive relationship between productivity and area. This could be attributed to black headed hairy cater-pillars widespread in some years in the coconut belt in the district sometimes totally the trees. To combat this disease, an integrated approach like pesticides application could be done collectively by the concerned farmers. To strengthen the hands of the farmers, pesticides may be supplied at low cost through State intervention.

Table 5: Area, Production and Average yield of coconut

(Annual Growth Rate)

Year	Area		Production		Average Yield	
	Karnataka	Tumkur	Karnataka	Tumkur	Karnataka	Tumkur
1982-83	3.52	0.56	3.72	1.49	0.20	0.93
1983-84	4.23	3.48	4.30	3.20	0.08	–0.27
1984-85	5.33	6.04	4.65	5.92	–0.66	–0.12
1985-86	2.57	3.01	2.52	3.18	–0.04	0.17
1986-87	0.85	0.18	0.69	0.11	–0.16	–0.08
1987-88	2.79	0.60	2.88	0.66	1.10	0.00
1988-89	3.39	2.70	3.43	2.74	0.0	0.03
1989-90	2.70	1.48	2.82	1.46	0.12	–0.11
%age increase (1981-82 to 1989-90)	28.26	19.37	27.85	20.73	0.33	0.00

Note: Area in hectares, Production in 000' nuts, Average yield nuts/per hectare.

Source: Same as Table 3

The area under mulberry has increased from 4,709 hectares to 8,594 hectares in Tumkur district from 1981-82 to 1989-90. The increase during the period was 77 per cent and 24 per cent in Tumkur district and in the State, respectively (table 6). As a result of this, both coconut production and silk production have increased by 115 per cent and 144 per cent respectively in the district, which is higher than the State figures of 72 per cent and 94 per cent. About 89 per cent of the mulberry crop is irrigated in the district. Since this crop generates more income and employment opportunities in the rural areas, it is encroaching upon the area of irrigated ragi and groundnut crops too. During 1981-82 the mulberry area under irrigation condition was 4,015 hectares, which increased to 7,683 hectares in 1989-90 (i.e. 98 per cent).

Table 6: Area, Production and Yield of Mulberry crop in Karnataka and Tumkur District

(Annual Growth Rate)

Year	Area		Production		Average Yield	
	Karnataka	Tumkur	Karnataka	Tumkur	Karnataka	Tumkur
1982-83	2.73	9.82	12.63	– 12.16	4.72	18.02
1983-84	2.26	4.29	6.30	– 44.98	19.79	– 36.87
1984-85	1.75	2.19	1.14	195.30	3.33	196.62
1985-86	4.62	9.57	5.13	6.43	5.93	– 5.68
1986-87	5.05	22.73	3.98	1.09	8.62	5.62
1987-88	0.96	3.65	6.41	5.32	6.42	5.32
1988-89	0.59	2.36	6.98	10.45	6.92	10.46
1989-90	3.53	5.35	14.78	36.97	14.27	36.92
%age increase (1981-82 to 1989-90)	23.55	77.16	72.22	115.08	94.31	143.60

Source: Same as Table 3

Table 7 presents growth rates of area, production and yield per hectares of selected crops between the two points of time, i.e. 1981-85 and 1988-89. The average of these four years has been taken as a point of time to balance the annual or seasonal fluctuations in areas and yield due to exogenous factors. In Karnataka, ragi shows a negative trend in terms of area, production and productivity. The time series data shows that the decline in the area under ragi has been taken over by groundnut crop. But in Tumkur district, it has recorded a mixed trend of increase in area and production (though not significantly) and decrease in yield per hectare. In the case of commercial crops, Tumkur district has recorded a phenomenal growth in area and production while the yield per hectare too has registered a significant growth. The farmers' preference is more in favour of remunerative commercial crops than the price controlled food crops.

The farmers' preference is more in favour of remunerative commercial crops than the price controlled food crops.

Table 7: Selected Crops and their Area, Production, Yield in Karnataka and Tumkur District

(Growth Rate)

Crops	1981-82 to 1984-85 and 1985-86 to 1988-89					
	Karnataka			Tumkur		
	A	P	Y	A	P	Y
Ragi	3.87	24.31	7.4	11.09	3.55	– 6.63
Coconut	12.88	22.63	– 0.50	10.78	10.91	0.12
Groundnut	22.07	16.35	– 0.88	40.68	64.56	10.11
Mulberry	12.68	33.80	—	39.53	64.46	—

Note: A = Area in Hectares
P = Production in Tonnes/Production in '000 nuts
Y = Average Yield kgs/nuts per hectare
Source: Same as Table 3

Conclusions & Implications

On analysing the commercialisation of agriculture in Tumkur district, the trend that emerges is that the farmers

are motivated towards commercial crops. The balance of cropping pattern is tilting towards cash crops with reduced emphasis on food crops like ragi which fetch a low price. In rural areas if farmers harvest one quintal of groundnut which fetches Rs. 800 - 1000, with the same money they can purchase more than 3 quintals of ragi.

Though the number of small and marginal farmers is little over 70 percent at disaggregated level (i.e. Tumkur district), the land owned and cultivated by them is not in the same proportion. The cropping pattern during 1988-89 shows that ragi crop and groundnut crop covered around 60 percent of the total cultivated land in the district. Though the cost of cultivation per hectare of ragi (Rs. 2,411) and groundnut (Rs. 2,326) are almost the same, the net returns are in favour of groundnut crop, farmers are not evincing keen interest in cultivating the food crop (ragi). The growth of area and productivity of ragi are almost stagnant, while the same of groundnut and other commercial crops show substantial growth in the district.

Policy measures like price control and public distribution system to contain the prices of food crops have resulted in lack of motivation on the farmers' side for cultivating cereal crops, leading to commercialisation of agriculture. To have a balanced cropping pattern and to solve food scarcity problems, farmers should be given incentives to go in for food crops. This is what is happening at micro/regional level i.e. Tumkur district. If the same trend emerges at the national level, will Ricardo's "Comparative cost theory" hold good even at the micro level?

To have a balanced cropping pattern and to solve food scarcity problems, farmers should be given incentives to go in for food crops.

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References

Directorate of Economics and Statistics, Government of Karnataka, Bangalore, 1990.

Directorate of Economics and Statistics, Karnataka at a glance, Government of Karnataka, Bangalore 1990-91.

Karnataka Cooperative Milk Producers' Federation Limited, Bangalore, 1989.

Census of India, 1981, Series 9, Karnataka Part IIA, General Population Tables.

Census of India, 1981, Series 9, Karnataka Part IIB, 1 Primary Census Abstract General Population Tables. Quoted in Statistical Outline of Karnataka 1987-88, Directorate of Economics and Statistics, Government of Karnataka, Bangalore, 1990.

Rao, V.M. & Erappa. S. "Development Opportunities in Dryland Agriculture: in Agriculture Development Policy: Adjustments and Re-orientation. The Golden Jubilee of the Indian Society of Agricultural Economics, Oxford and IBH Publishing Company Pvt. Ltd., New Delhi, 1990. □

Responsibility

If anything fails in an organisation, it is the failure of the management.

— Akio Morita

Structure & Behaviour of Prices of Indian Pepper

P.D. Jeromi & A. Ramanathan

Pepper which is an export oriented commercial crop has recently been facing the problems of unviable prices and dismal export performance. The authors analyse the growth, instability and seasonal variations in the price of Indian pepper and suggest various measures to be implemented to improve the current scenario.

P.D. Jeromi & A. Ramanathan are UGC Junior Research Fellow and Asso. Prof. in Economics, respectively, Department of Humanities and Social Sciences, Indian Institute of Technology, Bombay-400 076

Pepper (*piper nigrum*), famed as the 'king of spices' or 'black gold', is a significant foreign exchange earner for India. The regions covering the West Coast, comprising the whole of Kerala, coastal Karnataka, southern parts of Tamil Nadu and some parts of Pondicherry and Maharashtra form the pepper belt of India. The crop area and production in India have increased from 80 thousand hectares and 21 thousand tonnes in 1950-51 to 156 thousand hectures and 65 thousand tonnes, respectively, in 1989-90. Among the states, Kerala accounts for a lion's share (97 per cent) of area and production of pepper in the country.

Since pepper is an export oriented commercial crop, its cultivation heavily depends upon the export performance and the price of the produce. Current trends indicate that there are problems on both these fronts. India's contribution to world exports has drastically come down from 56 per cent in 1950-51 to 23 per cent in 1990-91. In particular, during the period 1987-88 to 1990-91, the quantity and export value have declined from 39.58 thousand tonnes and Rs. 235.97 crores to 34.43 thousand tonnes and Rs. 111.04 crores, respectively (Jeromi & Ramanathan, 1993). Further, as compared to other major producing countries, productivity of Indian pepper is low. In India, productivity per hectare is only 411 kilograms as against 2347 kilograms in Malaysia, 1433 kilograms in Brazil and 496 kilograms in Indonesia.

The sudden spurt in pepper prices (wholesale) from Rs. 12.17 per kg. in 1982-83 to Rs. 55.62 per kg. in 1987-88 had encouraged its extensive cultivation by substituting the area under the alternate crops such as coffee and rubber. However, the favourable price situation started changing since 1987-88 and by March 1993 the price has touched a bottom of Rs. 26 per kg. The decelerating trends in prices, poor yield and unfavourable trends in exports etc., have been forcing the farmers to

reverse the conversion of crop area and they are demanding fixation of minimum support prices, at least to maintain the present area under cultivation. The present paper aims to undertake a temporal analysis of the structure and behaviour of prices of Indian pepper during the period 1960-61 to 1990-91. Specifically, the paper examines the growth, instability and seasonal variations in farm, wholesale and export prices of pepper; the relative price movements of pepper in terms of alternate crops and competing countries; the behaviour of price transmission and price spread of pepper and the rationale behind the demand for the fixation of minimum support price based on "Full Supply Price" (FSP) concept.

Since Kerala dominates in crop area, production and exports, farm and wholesale prices of pepper in the sate are treated as representing all the India scenario. The study further considers rubber, cardamom and coffee as the alternate crops for pepper. The analysis relating to FSP of pepper is based on primary data pertaining to Kerala state.

Seasonal Variations of Pepper Prices

To get an overall idea about the trends in pepper prices and its volatilities, an exponential model of the type $\ln Y_t = \alpha + \beta t + e_t$ (where y = variables under study and t = time) has been fitted, using Ordinary Least Squares technique. Decade-wise growth rates have been estimated by fitting two-kinked exponential function (Boyce, 1986). The instability index (II) is estimated using the following statistics from the residuals (e_i) of the exponential trend equation:

$$II = \sqrt{\sum_{(n=k)}^{n} e_i^2}$$

where e_i = residual of i^{th} observation

n = number of observations

k = number of parameters estimated

The farm, wholesale and export prices of pepper per kg have increased from Rs. 4.03, Rs. 3.68 and Rs. 4.94 in 1960-61 to a peak of Rs. 52.23, Rs. 55.19 and Rs. 59.62 in 1987-88 and since then have plumped to Rs. 31.50, Rs. 33.35 and Rs. 32.25 in 1990-91. Table 1 shows that, during the period 1960-61 to 1989-90, the annual compound growth rate of prices at all levels were around 10 per cent. Decade-wise annual growth rates show that momentum in growth had been experienced during 70's, and 80's recorded the highest growth, at all levels of prices. During the first half of 80's, the prices recorded a substantial growth. However, the later half witnessed significant negative growth. In general, the instabilities in prices were more pronounced during 70's and 80's and it was highest in the case of export price (EP).

Table 1: Growth Rates and Instability Indices of Pepper Prices

	Farm price		Wholesale price		Export price	
Period	ACGR	II	ACGR	II	ACGR	II
1960-69	3.36	0.19	5.49*	0.11	6.23*	0.17
1970-79	14.56*	0.20	13.90*	0.33	12.26*	0.69
1980-89	24.83*	0.32	22.26*	0.48	23.73*	0.56
1960-89	10.52*	0.20	10.34*	0.24	9.93*	0.37
1981-85	32.61*	0.20	33.33*	0.18	35.70*	0.19
1986-90	-11.22*	0.09	-10.65*	0.12	-14.18*	0.11

ACGR = Annual compound growth rate

II = Instability index

* Statistically significant at 99 per cent confidence interval

Source: Computed from 1) Agricultural Prices in India, (various issues) Directorate of Economics and Statistics, Government of India, New Delhi

2) Economic Review, (various issues) State Planning Board, Government of Kerala, Trivandrum

3) Spices Export Review, Spices Board, Cochin

Seasonal Farm Price Variations

In India, the harvesting period of pepper starts from December and ends by March. However, the commodity is demanded throughout the year. Index numbers of seasonal farm price (FP) variations have been estimated by following the ratio to centered 12-month moving average method (Chakravarthy et al, 1967) and are given in table 2. The table shows that for the season covering the months of December, January, February and March, the farm prices declined by 4.5, 3.8, 3.4 and 2.4 percent respectively, during the period 1970-71 to 1989-90. During the rest of the months, prices were higher than the average price. The price was the highest during the month of June (4.7 per cent above the average price). Further, the monthly FP has peaked four times each in the months of June and November and three times each during August and October. Again, the lowest FP of pepper has been recorded 14 times during the harvesting months. Therefore, it can be inferred that the farmer's income can be increased if the produce is marketed after the harvest season.

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Table 2: Seasonal Farm Price Indices of Pepper and Distribution of Months According To Maximum and Minimum Prices Recorded (1970-71 to 1989-90)

Month	Seasonal Farm Price Index	No. of Years When Price Was	
		Maximum	Minimum
January	96.11	1	5
February	96.60	0	3
March	97.60	0	1
April	102.07	1	0
May	101.51	0	1
June	104.73	4	0
July	103.31	2	0
August	100.79	3	1
September	100.12	1	1
October	100.58	3	1
November	101.05	4	2
December	95.47	1	5

Source: Computed from Economic Review, (various issues) State Planning Board, Government of Kerala, Trivandrum.

Relative Price Movements of Pepper

Alternate Crops

The farmer's allocation of land and other resources for pepper cultivation mainly depends on the relative price movements of the crop in terms of its alternate crops. Wholesale price (WP) movements of major alternate crops of pepper in Kerala-rubber, cardamom and coffee are analysed and compared with that of pepper (table 3). Results show that during 1960-61 to 1989-90, the rate of growth of pepper prices was substantially higher than the corresponding growth rates of alternate crops. However, its impact has not been reflected in the growth of area and production of pepper. Decade-wise analysis reveals that the rate of growth of price of pepper was less than its alternate crops during 60's and higher during 70's and 80's. Although the growth of prices of alternate crops was insignificant during the whole period, the respective growth rates of area and production were higher than the corresponding figures for pepper.

To get a deeper insight, an inter-temporal analysis for two sub-periods, ie., from 1960-61 to 1974-75 (sub period 1) and from 1975-76 to 1989-90 (sub period 2), has been carried out. A dump variable regression model of the following form has been estimated in this regard:

$$(P_i/P_k)t = \alpha + \beta D$$

where, P_i = Price of the i^{th} competing crop;

P_k = Price of pepper;

D = Dummy variable assuming the value 0 for the sub period 1 and 1 in the sub period 2; and

t = time.

Table 4 reveals that all the estimated functions are statistically significant except in the case of cardamom. In sub period 1, all alternate crops had a price advantage over pepper (all the mean relative prices) are higher than one). However , in period 2 the price disadvantage of pepper has declined in relation to rubber and coffee (mean relative prices of rubber and coffee have declined from 1.16 to 0.81 and 1.28 in 0.98, respectively). Price movements of pepper in relation to the three alternate crops taken together was identical in sub period 2.

Competing Countries

India's price advantage in the international market can be gauged by examining the relative price movements in terms of her competing countries. Twenty six yearly observations of relative export prices covering a cross section of countries for the period 1965 to 1990, revealed that on five occasions India had lost its premium over Indonesia, six times over Malaysia and four times over Brazil. In the remaining years, India had enjoyed price advantage over the above countries. Results of the inter-temporal analysis of variations in relative prices during two sub-periods i.e. from 1965 to 1977 (sub period 1) and from 1978 to 1990 (sub period 2) are presented in Table 5 (price figures are averages for the respective periods). Compared to sub period 1, India's price advantage has declined as against Indonesia and Malaysia and improved against Brazil during the sub period 2. It can be inferred that India's price advantage over other countries has been eroded over the recent years.

Price Transmission

The direction of commodity price transmission may be such that either the price at the wholesale and retail level originates from *FP* or the farm level price is influenced by the wholesale and retail prices. Pepper being an export oriented commodity, it is assumed that its farm and wholesale prices are determined by the *EP* (Mundlak & Larson, 1992). To estimate the direction and magnitude of price transmission, the following two variable linear equations have been used:

$$FP = \alpha + b(EP) + u_1 \quad (1)$$

$$WP = \alpha + c(EP) + u_2 \quad (2)$$

$$FP = \alpha + d(WP) + u_3 \quad (3)$$

where, FP = Farm Price
EP = Export Price
WP = Wholesale Price

To test the above hypothesis, the value of the coefficient of determination (R^2) and its significance for the above three functional specifications have been considered. The three equations have been fitted to the data for the period 1960-61 to 1989-90 and the results are presented in table 6. For all the equations, the coefficient of determination (R^2) was 0.99. Thus, prices of pepper at the farm and wholesale levels are determined by the *EP*.

To evaluate the efficiency of the marketing system in transmitting price changes to the different levels of

Table 3: Growth Rates of Area, Production and Wholesale Prices of Pepper and its Alternate Crops in Kerala — 1960-61 to 1989-90

	Pepper			Rubber			Coffee			Cardamon		
Period	Pr.	Ar.	Prod.	Pr.	Ar.	Prod.	Pr.	Ar.	Prod.	Pr.	Ar.	Prod.
60-69	5.5*	0.8*	-2.4*	5.6*	3.2*	8.0*	6.6*	7.1*	7.0*	19.0*	3.4*	3.9*
70-79	13.9*	-1.5*	-0.6	-0.1	3.5*	8.1*	0.0	7.0*	7.1*	0.0	3.6*	3.7*
80-89	22.3*	4.9*	6.4*	3.8*	5.6*	9.9*	10.3*	1.3*	2.8*	5.7*	4.7*	2.9*
60-89	10.3*	1.0*	1.3*	0.3	3.6*	7.3*	0.2	5.6*	5.3*	0.4	3.0*	3.6*

Pr = Price; Ar. = Area Prod. = Production
* Statistically significant at 95 per cent confidence interval
Source: Computer from 1) Economic Review, (various issues) State Planning Board, Government of Kerala, Trivandrum. 2) Agricultural Prices in India, (various issues) Directorate of Economics and Statistics, Government of India, New Delhi.

Table 4: Regression Analysis of Relative Prices of Pepper on Time Dummy Variable (Period 1 1960-61 to 1974-75, Period 2 1975-76 to 1989-90)

Dependent Variable (Price of pepper in relation to)	Intercept α (mean relative price in period 1)	Coefficient β (change in relative price in period 2)	$\alpha + \beta$ (mean relative price in period 2)	R^2
Rubber	1.1674	-0.3508	0.8166	0.2198*
Cardamom	1.6476	0.3708	2.0184	0.1309
Coffee	1.3756	-0.6240	0.7516	0.6223*
All alternate Crops[1]	1.2813	-0.2915	0.9898	0.2340*

* Statistically significant at 95 per cent confidence interval.
1. Based on the composite price index (weighted) of the above three alternate crops.
Note: a) If the mean value is unity, price movements are the same.
b) If the mean value is less than unity, relative price movements are in favour of pepper.
c) If the man value is greater than unity, relative price movements are against pepper.

Table 5: Average Prices of Pepper of Major Producing Countries and its Percentage to Indian Pepper (US Cents/1b in New York Market)

Period	India	Indonesia	Malaysia	Brazil
1965-77	55.6	52.4	48.2	52.0
	(100)	(94)	(87)	(94)
1978-90	133.1	128.3	123.5	104.2
	(100)	(96)	(93)	(78)
1965-90	94.3	90.3	85.9	78.1
	(100)	(96)	(97)	(83)

Note: Figures in brackets represent price relatives expressed as percentage.
Source: Pepper Statistical Year Book, (various issues), International Pepper Community, Indonesia.

Table 6: Estimate of Price Transmission Function of Pepper (1960-61 to 1989-90)

Equation	Slope	Standard Error	R^2	H_0	H_a	t value (1-Slope/S.E.)	Inference on H_0*
FP = a+b (EP)	0.883	0.014	0.99	b=1	b<1	8.09	Rejected
WP = a+c (EP)	0.893	0.015	0.99	c=1	c<1	7.06	Rejected
FP = a+d (WP)	0.983	0.020	0.99	d=1	d<1	0.84	Accepted

* Inference based on 99 percent confidence interval.

Table 7: Price Spread of Pepper (1960-61 to 1989-90)

Period	Farm Share		Market Share (M)		Wholesaler's Share		Exporter's Share	
	Rs/kg	% of EP	Rs/kg	% of EP	Rs/kg	% of EP	Rs/kg	% of EP
1960-69	3.51	77.33	1.11	22.67	0.31	6.68	0.80	16.00
1970-79	10.67	79.02	2.60	20.98	1.03	8.76	1.58	12.21
1980-89	28.62	87.27	4.23	13.21	0.91	3.50	3.32	9.72
1960-89	14.26	81.21	2.65	18.65	0.75	6.31	1.90	12.64

EP = Export Price,
Market Share (M) = Farm-Export price spread
Wholesaler's share (m_1) = Farm-wholesale price spread and
Exporter's share (m_2) = Wholesale-export price spread

Table 8: Discounted Values of Costs and Yield and Full Supply Price (FSP) of Pepper in Kerala

Discounted Values of	Discount Rate					
	10%		13%		15%	
	Cost	FSP	Cost	FSP	Cost	FSP
Cost A	146582	24.45	120912	26.45	108078	27.98
Cost B	171448	28.61	141472	30.95	126050	32.63
Cost C	183295	30.58	150876	33.00	135217	35.00
Cost D	221695	36.99	181411	39.68	160711	41.60
Yield	5993		4572		3863	

(Costs in Rs./Hectare, Yield in kg./Hectare and FSP in Rs./kg.)
Notes: 1) Cost A — Consists of cash and kind expenses (paid-out-costs) actually incurred by the growers.
2) Cost B — Cost A + cost of fixed capital which includes interest on fixed capital and depreciation allowances.
3) Cost C — Cost B + Imputed value of family labour.
4) Cost D — Cost C + Rental value of land based on 1/5th of the produce.
Source: Computed from Jeromi (1991).

markets (wholesale and farm), the regression coefficients of the above models have been examined based on the following null and alternative hypotheses for the period 1960-61 to 1989-90:

1) $H_0 : b = 1$; 2) $H_0 : c = 1$; 3) $H_0 : d = 1$
1) $H_a : b < 1$; 2) $H_a : c < 1$; 3) $H_a : d < 1$

If the null hypotheses are accepted (i.e., if the slope coefficients are not statistically different from unity), the price transmission is efficient. In table 6, the first and second functions show that a rupee change in export price led to a rise of 0.88 rupee change in *FP* and 0.89 rupee change in *WP* and the third function shows that a rupee change in *WP* has given rise to 0.98 rupee change in *FP*. The estimated coefficients are statistically different from one in equations (1) and (2) and equal to one in equation (3). Pepper marketing therefore, appears to be inefficient in transmitting *EP* to *FP* and *WP* and efficient in transmitting from *WP* to *FP*.

Price Spread

Price spread is defined as the difference between the price paid by the consumers and that obtained by the farmers. To estimate the size of price spread and the shares of farmers and market intermediaries in *EP*, the following simple algebraic expressions have been used:

m_1 = 'Farm-wholesale price spread' = $WP - FP$;
m_1/EP = Share of wholesaler in *EP*

m_2 = 'Wholesale-export price spread' = $EP - WP$;
m_2/EP = Share of exporter in *EP*

$M = m_1 + m_2$ = 'Farm-export price spread' = $EP - FP$;
M/EP = Market share ($m_1/FP + m_2/EP$)

$(EP - M)/EP$ = Farm share in *EP*.

Relevant results presented in table 7 show that the average absolute farm-export price spread (market share), *M*, was 19 per cent of *EP* during the period 1960-61 to 1989-90. Alternatively, on an average, 81 per cent of the *EP* has accrued to the farmers. The average farm-wholesale price spread (wholesalers share), m_1, was 6.31 per cent of *EP*. The average wholesale-export price spread (exporters share), m_2, was 12.64 per cent of *EP*. Over the years, the share of market intermediaries has tended to decline in favour of farmers.

Full Supply Price of Pepper

This section examines the rationale behind the farmers' demand for the fixation of minimum support prices based on full supply price of pepper. FSP is defined as the price which, if received over the entire life of the crop, would cover all cost and would provide a desired rate of return on all capital involved in the production (Grilli, 1980). It equates the present value of all expenditures to the present value of all receipts at a fixed rate of discount. FSP not only includes actual expenditures incurred in production, but also a charge for interest and takes into account the change in the production capacity of the crop during its life time.

FSP of pepper has been estimated as follows:

$$FSP = \frac{\sum_{i=1}^{n} \frac{C_t}{(1+\delta)t}}{\sum_{i=1}^{n} \frac{Q_t}{(1+\delta)t}}$$

where, C = Cost of cultivation of pepper;
Q = yield in kg;
δ = Discount rate;
t = Year.

The estimation is based on the primary data on cost and yield collected from 84 farmers covering three major pepper producing districts of Kerala, namely, Waynad, Idduki and Cannanore in 1991. To calculate the FSP of pepper, three discount rates have been used 10, 13 and 15 per cents. Here, the 13 per cent rate of discount represents the expected rate of return from alternative investment opportunities and the rates 10 and 15 per cents have been used to find the extent of variations in the required price. Table 8 gives the per hectare discounted costs and yield, during the 20 years life-time of pepper, at 1991 prices. It can be noted that FSP of pepper, based on costs A and B at the selected rates of discount, was lower than the price of Rs. 33 per kg. received by the farmers. However, FSP based on cost D at 13 per cent discount becomes Rs. 39.68 per kg. This is, perhaps, the most reasonable price which should be ensured to safeguard the interests of the farmers.

Summary & Policy Suggestions

The major findings of the study are as follows: Pepper prices, at all levels, recorded high growth and volatility during 80's and since 1987-88 they had started declining. Prices are lower during the harvesting months, and higher during off-season months. The relative price movements of pepper in terms of its alternative crops have tended to be identical since 1974-75. India has been enjoying price advantage over its competitors throughout the period, however, the degree of advantage has declined during recent years. Full supply price of pepper has been estimated at Rs. 39.68 per kg. Prices at the farm and wholesale levels are determined by the *FP*. While the price transmission from *WP* to *FP* is found to be efficient, transmission from *EP* to *FP* and *WP* are less efficient. The farm and market shares in the *EP* of pepper are 81 per cent and 19 per cent, respectively and the share of the farmers has increased over the years. Out of the market share, 13 per cent accrues to the exporters and the remaining 6 per cent to the wholesalers.

Of late, pepper producers are facing serious problems due to the unfavourable trends in prices. This situation may lead to large scale conversion of area under pepper to its alternative crops and the consequent reduction in export earnings in the coming years. Therefore, as a short term solution, the government can fix a minimum support price, to maintain the present area and production levels of pepper. As revealed by the study, the minimum support price needs to be higher than Rs. 40 per kg.

As a short term solution, the government can fix a minimum support price, to maintain the present area and production levels of pepper.

Since the domestic price of pepper heavily depends on the international prices, measures should be taken to stabilise the latter at higher level. At present, the international prices of black pepper is well below the Minimum Export Price (MEP) of one dollar per pound fixed by the International Pepper Community (IPC). Therefore, IPC should effectively implement the MEP policy and the member countries (India, Indonesia, Malaysia and Brazil) must strictly follow it. The international prices and its fluctuations are mainly due to the changes in the supply conditions than the demand factor. World demand is unlikely to vary substantially in view of its specific and fixed nature of uses. Hence, introduction of an efficient supply management system either by maintaining a buffer stock by the IPC or voluntary retention by the producing countries is required for obtaining higher and steady prices. Apart from over supply, under-cutting by non-IPC countries like Vietnam, Thailand and Sri Lanka, has contributed to the unprecedented decline in international

prices. Hence, efforts should be made to pursuade these countries to join IPC and thereby strengthen the bargaining power of the Community members.

Introduction of an efficient supply management system either by maintaining a buffer stock by the IPC or voluntary retention by the producing countries is required for obtaining higher and steady prices.

India's declining price advantage is a cause for concern, especially in the context of the recent opening up process in the East European Region, which had been accounting for more than half of our pepper exports through rupee trade agreements. Therefore, measures should be taken to enhance the competitive power in the international market, which in turn requires reduction in the unit cost of production through productivity measures. In fact, India's lower productivity forms the crux of the problem. Therefore, productivity improvement measures such as cultivation of high yielding varieties of pepper vines, rejuvenation of old vines, application of fertilizers, adoption of disease and pest control measures, practising of scientific method of cultivation etc., should get emphasis. Spices Board should take care of the production aspects of the crop, apart from concentrating on exports. Further, the reasons for the inefficiencies in price transmission from the export price to the farm and wholesale prices should be traced and measures should be taken to enhance the marketing efficiency so as to increase the share of farmers in the export price.

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REFERENCES

Boyce, J.K., "Kinked Exponential Model for Growth Rate Estimation",. Oxford Bulletin of Economics and Statistics, vol. 48(4), 1986.

Chakravarthy et al., Handbook of Applied Statistics, John Wiley and Sons, Inc. New York, 1967.

Grilli R. Enzo et al., The World Rubber Economy — Structure, Change and Prospects, World Bank Staff Occasional Papers, The Johns Hopkins University Press, Baltimore and London, 1980.

Jeromi, P.D., Economics of Pepper Production in Kerala, M.Phil thesis, Department of Economics, University of Kerala, Trivandrum, 1991.

Jeromi, P.D. & Ramanathan A., "World Pepper Market and India: An Analysis of Growth and Instability", Indian Journal of Agricultural Economics, vol XLVIII, No. 1, January-March, 1993. (under press).

Mundlak Yair & Donald F. Larson, "On the Transmission of World Agricultural Prices". The World Bank Economic Review, vol. 6, No. 3, 1992. □

Basic Question

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

– Alvin Toffler

Growth & Instability in Rubber Plantation Industry in India

V. Nanda Mohan & Sunny George

Indian rubber industry has been witnessing significant strides in growth in recent years. But a tremendous scope still exists for improvement. Understanding the trends and sources of growth is indispensable for the formulation of a development plan. This article attempts such a study of the rubber industry.

V. Nanda Mohan is Head of the Department of Futures Studies, University of Kerala, Trivandrum, 695034. Sunny George is Post Doctoral Fellow in the Department of Applied Economics, Cochin University of Science & Technology, Cochin 682022.

Natural rubber is an important plantation produce which serves as a vital raw material for several industries. There exists hardly any segment of life which does not make use of products based on rubber and the number of rubber products is ever on the increase. In addition to natural rubber, the rubber plants produce honey[1] and rubber seed oil[2]. The rubber plantation industry generates employment opportunities particularly in rural areas. Furthermore, being a plantation crop, it reduces the stress on forests providing timber[3] for manufacturing wood products (Oommen, 1992), on the one hand, and supplying firewood, on the other.

India is one of the largest rubber producing countries in the world. It occupies fourth place in production and eight place in domestic consumption of natural rubber. On account of the significant growth in production, area, and productivity/yield,[4] now we have almost attained self-sufficiency in producing natural rubber. However, in view of the low per capita consumption of products based on rubber,[5] compared to other countries, and of the ever increasing application of natural rubber, the demand for it is bound to increase in the years to come. Though synthetic rubber is a close substitute for natural rubber, the

1. Rubber tree is a prolific producer of honey. It is estimated that honey from rubber plantations accounts for 45 per cent of the total production of honey in India (Rubber Board, n.d., 70).
2. Rubber seed oil is a minor source of non-edible oil in India. It is estimated that 4000 tonnes of rubber seed oil is produced per year.
3. Recently rubber wood has assumed importance as a source of raw material for various industries in India. Around 1.2 million cmt. of rubber wood is produced annually of which 60 per cent is stem wood (round wood) and the rest branch wood.
4. It is presumed that the reason for the sustained growth in the rubber plantation industry in India is the encouragement given by the government (Mani, 1992; Tharian et al., 1988).
5. In India the per capita consumption of rubber is as low as 0.56 kg. as against 10.11 kg in the U.S.A., 10.33 kg. in Canada and 14.63 kg. in Japan.

former's production requires large quantities of oil based raw material and its import will leave a toll on the existing foreign exchange reserves. However, the productivity/yield differential between the rubber plantation industry in India and in other major producing countries in the world is significant. Thus, the development of rubber plantation industry is crucial for the Indian economy in many respects.

Growth of Output, Area & Yield

Growth rate of a variable may be defined as the rate of change per unit of time, usually a year. The growth rate can be measured statistically by estimating different functional forms of growth overtime such as linear, semi-log, Geompertz curve, logistic curve, etc.; each one of these having certain unique characteristics. In the present study, however, we employ an exponential trend, which approximates best the uniform rate of growth, and a log-quadratic trend, which is an extension of an exponential equation by adding a quadratic term. The quadratic equation is useful to test whether the growth rate is uniform or accelerating/decelerating. Equations (1) and (2) represent the exponential and log-quadratic trend respectively.

$$\ln Y = a + bt \qquad (1)$$

$$\ln Y = a + bt + ct^2 \qquad (2)$$

Now to get the growth rates, differentiating equations (1) and (2) with respect to time,

$\frac{d(\ln Y)}{dt} = b$ for the exponential trend, and

$\frac{d(\ln Y)}{dt} = b + 2ct$ for the log-quadratic trend equation.

Thus, while the exponential trend growth rate is uniform over the period of estimation, the log-quadratic equation represents a varying rate of growth. In our empirical analysis we estimated both exponential and log-quadratic equation. If the co-efficient of the quadratic term in equation (2) statistically not significant, we safely conclude that the rate of growth is uniform across the period and growth rate given by exponential trend equation (1) is used for analytical purpose.

Estimates used in this study are based on data from the Rubber Board. Growth rates of output, area and productivity over the period of analysis (1955/56 to 1991/1992) are found to be uniform as the co-efficients of the estimated quadratic equation are very low and/or not significant. Thus, the growth rates are estimated as exponential constants over the period of study. The estimated growth rates are presented in table 1. There has been significant growth in the rubber plantation industry in India. The output growth averaged about 7.8 per cent per annum between 1955/56 and 1991/92. The contributory factors of output growth, area and productivity, have also been growing at about equal rate of growth – around 3.5 per cent per annum over the reference period.

Table 1: Growth Rates of Area, Output and Yield of Rubber

State	Growth Rate 1955/56 to 1991/92		
	Area	Output	Yield
Kerala	3.5	7.9	3.7
Karnataka	7.0	9.5	4.0
Tamilnadu	3.7	6.4	2.1
All India	3.8	7.8	3.5

Note: Growth rates are estimated by fitting an exponential trend equation.

This trend in growth, however, conceals the spatial differentials in growth; that is to say, the growth rate has not been uniform across all regions of cultivation. Karnataka reported 9.5 per cent growth in output per annum between 1955/56 and 1991/92, while the respective figures for Kerala and Tamilnadu are 7.8 and 6.4. In the case of growth rates of area and yield also Karnataka is found to be far ahead of Kerala and Tamilnadu: The growth rate of area is 7 per cent per annum while that of yield is 4 per cent per annum for Karnataka. A notable feature is that the estimated growth rates for Kerala and all India are very close, this is simply because of the fact that Kerala accounts for the largest share of output (about 92 per cent of total output). Thus, one has to bear in mind, while analysing the growth estimate that the differences in absolute measures are very high.

On a closer look at the variables under consideration, we may observe a trend break in 1976/77. Hence one may suspect some structural shift in the growth pattern in the Indian rubber plantation industry. When there is a structural shift (trend break) we need separate growth rates for the two time periods. Independent estimates for the periods would lead to unreliable conclusions as pointed out by Boyce (1987). In order to estimate period-wise growth rates without any discontinuity Kinked Exponential Model developed by Boyce is employed. Thus the discontinuous growth rates for the two sub-periods are estimated separately using the following equation developed by Boyce.

$$\ln Y_t = a_1 d_1 + a_2 d_2 + (b_1 d_1 + b_2 d_2)\, t + u_t \qquad (3)$$

where $d_1 = 1$ for 1955/56 to 1976/77

$= 0$ otherwise.

d_2 = 1 for 1977/78 to 1991/92

= 0 otherwise.

The discontinuity between the two trend lines can be eliminated by a linear restriction at the break point, k,

$$a_1 + b_1k = a_2 + b_2k$$

From the above restriction, we have,

$$a_2 = a_1 + b_1k - b_2k \quad (4)$$

and $$d_2 = 1 - d_1$$

Substituting (4) in (3), we have,

$$\begin{aligned} \ln Y_t &= a_1d_1 + (a_1 + b_1k - b_2k)d_2 \\ &\quad + (b_1d_1 + b_2d_2)\, t + u_t \\ &= a_1d_1 + a_1\,(1 - d_1) + b_1\,(d_1t + d_2k) \\ &\quad + b_2\,(d_2t - d_2k) + u_t \\ &= a_1 + b_1\,(d_1t + d_2k) + b_2\,(d_2t - d_2k) + u_t \quad (5) \end{aligned}$$

The estimated values for b_1 and b_2 in equation (5) will be the growth rates for the first period and second period respectively.

Table 2 presents the period-wise estimation of discontinuous growth rates for two time periods: period I, from 1955/56 to 1976/77; and period II, from 1977/78 to 1991/92. The rate of growth, in general, is lower in the second period compared to that of the first period, suggesting that the industry is reaching a stabilisation point. This tendency is particularly spectacular in the case of Kerala which recorded a fall in yield growth from 4.48 in the first period to 1.967 in the second period. Similar is the tendency of the all India figures and figures for Tamilnadu. The only state which reported an increase in growth in all the three variables under consideration is Karnataka. In order to understand the strength of the forces behind the observed changes in output growth, one has to decompose the output growth into area effect and yield effect.

Table 2: Growth Rates of Area, Output and Yield of Rubber

	Period I 1955/56 to 1976/77			Period II 1977/78 to 1991/92		
State	Area	Output	Yield	Area	Output	Yield
Kerala	5.01	9.49	4.48	2.92	4.89	1.97
Karnataka	3.34	6.72	3.38	9.04	13.78	4.75
Tamilnadu	5.26	8.23	2.98	2.63	3.23	0.60
All India	4.99	9.36	4.37	3.07	4.96	1.89

Notes (1) Period I: 1955/56—1977/78
(2) Period II: 1977/78 — 1991/92
(3) Growth rates are estimated by the Kinked exponential model.

The rate of growth, in general, is lower in the second period compared to that of the first period, suggesting that the industry is reaching a stabilisation point.

Growth Decomposition

Output growth can be partitioned into the contributions of changes in acreage and changes in output per unit area, or yield (Boyce, 1987). For this purpose the production function may be represented as:

$$Q_t = A_tY_t \quad (6)$$

where Q_t = output
A_t = Area
Y_t = yield
t = time point.

Given the above multiplicative identity, the exponential growth rates of the components on the right hand side sum up to the growth rate on the left-land side term, output:

$$b_Q = b_A + b_Y \quad (7)$$

where $\ln Y_t = a_Q + b_Qt$
$\ln A_t = a_A + b_At$
$\ln Y_t = a_Y + b_Yt$

Now the area effect and yield effect on output growth can be estimated by,

$$AE = \left(\frac{b_A}{b_Q}\right) \times 100 \quad (8)$$

where AE = area effect.

Similarly, yield effect (YE)

$$YE = \left(\frac{b_Y}{b_Q}\right) \times 100 \quad (9)$$

The estimated yield effect and area effect on output growth, for the period 1955/56 to 1991/92 are reported in table 3. The table reveals that the growth in area has an edge over yield on output growth: the percentage share of area effect and area effect at the all India level are 55.13 and 44.87 respectively. At the disaggregated state level also similar trend is found: area effect is greater than the yield effect. The lowest area effect and highest yield effect are found in Kerala.

Table 3: Decomposition of Output Growth into Area Effect and Yield Effect

State	(1955/56 — 1991/92) (%)		
	Output Growth	Area Effect	Yield Effect
Kerala	7.90	53.16	46.84
Karnataka	9.50	57.89	42.11
Tamilnadu	6.4	67.19	32.81
All India	7.8	55.13	44.87

Note: Area effect and yield effect are computed as percentage share of the respective growth rates to output growth: and for area tappable area is taken.

The decomposition of output growth is also made for two time periods – for 1955/56 to 1976/77 and for 1977/78 to 1991/92. The results are presented in table 4. As in the case of the total period, from 1955/56 to 1991/92, area effect seems to be dominating in explaining the output growth. Indeed, the area effect has increased from 53.34 per cent in the first period to 61.88 per cent in the second period. As a result, the yield effect has declined from 46.08 per cent to 38.097 per cent, during the same period. The tendency is also observed at the disaggregated state level. An alternative way of looking at the forces behind the dynamics of output is the analysis of instability. Such an attempt is made in the following section.

Table 4: Decomposition of Output Growth into Area Effect and Yield Effect (1955/56 — 1991/92) (%)

State	Period I			Period II		
	Output Growth	Area Effect	Yield Effect	Output Growth	Area Effect	Yield Effect
Kerala	9.486	52.836	47.249	4.886	59.660	40.258
Karnataka	6.719	49.680	50.335	13.783	65.570	34.426
Tamilnadu	8.227	63.875	36.125	3.233	81.318	18.650
All India	9.360	53.344	46.688	4.961	61.880	38.097

Note: (1) Period I: 1955/56 — 1976/77
(2) Period II: 1977/78 — 1991/92.
(3) Growth rates for two periods are estimated by employing the Kinked Exponential Model.
(4) Area effect and yield effect are computed as percentage share of the respective growth rates to output growth.
(5) For estimation tappable area is taken as area.

Instability & its Sources

Instability may be understood as the fluctuations from the trend. Thus, the instability is based on the trend eliminated value of the variables(MacBean, 1966). In the regression analysis we decompose the total variation into explained variation and unexplained variation. For the purpose of estimating the instability index, the unexplained variation in the regression analysis may be taken as the basis. In addition to the regression method, there are other methods for trend elimination. Hence there exist different measures of instability depending on the method of trend elimination. Among them, the simplest one is the MacBean Index[6] based on the moving average. It is defined as:

$$MBI = (100/n - 4) \sum_{t-3}^{n-2} (|X_t - MA_t|/MA_t) \quad (10)$$

where MA_t is a five year moving average of the X_t values (output, yield or area) centered on year t. The estimated instability indices for the two time periods are presented in table 5. The instability indices for area, output and yield at the national level, are observed to be higher during period II than in period I. In both the periods, the yield instability is lower than that of area instability. As in the case of the national level, the state level estimations show higher instability in the second period; and the yield instability is lower than that of area instability except in the case of Karnataka for the first period. Even though the output instability, in general, is in association with high area instability and yield instability, the overwhelming importance of area instability is spectacular. This tendency, however, needs further explanation. The contribution of components to the variance of the output instability and its sources may be measured in the following way (Pushpangadhan, 1988, 8-11).

Table 5: Instability Index of Area, Output and Yield of Rubber

State	Period I (1955/56 — 1976/77)			Period II (1977/78 — 1991-92)		
	Area	Output	Yield	Area	Output	Yield
Kerala	20.297	35.345	16.873	41.600	63.431	35.828
Karnataka	3.870	15.790	13.448	45.634	70.421	39.346
Tamilnadu	17.904	32.500	15.818	41.242	56.141	25.895
All India	19.867	34.898	16.774	41.809	63.203	35.210

Note: These Indices are based on Macbean Index.

Output (O) is a function of area (A) and yield (Y), thus

$$O = f(A,Y) \quad (11)$$

Assuming it as a multiplicative one, we have

$$O = A.Y \quad (12)$$

Taking logarithms on both the sides,

$$\ln O = \ln A + \ln Y \quad (13)$$

But the instability is defined as:

$$\ln O - \ln \hat{O} = \ln A - \ln \hat{A} + \ln Y - \ln \hat{Y} \quad (14)$$

$$\ln (O_I) = \ln (A_I) + \ln (Y_I) \quad (15)$$

6. For details, see McBean, (1966), 34.

where '^' means that they are trend values from an exponential growth function. Taking variance, we have

$$\text{Var}(\ln O_t) = \text{Var}(\ln A_t) + \text{Var}(\ln Y_t) \pm 2\text{Cov}(\ln A_t, \ln Y_t) \quad (16)$$

The contribution of each component is defined as the ratio of the variance of the component to the variance of the output. The covariance term shows whether they are moving in the same direction or in the opposite direction. The empirical results are reported in table 6. At the national level, the contribution of variance of area has increased while that of yield declined; the covariance term is positive and it remained more or less the same for the two time periods tending to suggest that the combined forces of area and yield positively affected uniformly across the time periods. Coming to the disaggregated state level analysis, this national tendency is reported only in Kerala; this may be due to the overwhelming influence of Kerala in total output. As against the above-mentioned trend, in the case of Karnataka and Tamilnadu, the contribution of variance of area declined while that of yield increased; and the observed changes in absolute measure is very high implying the significance in change. In the case of covariance term also, these two states contradict the results of the national level estimates. In the case of Karnataka, the covariance term switched over from a positive measure in the first period to a negative measure in the second period. And in the case of Tamilnadu, in both the periods, the covariance term is negative, and the absolute measure is higher in the second period. This phenomenon would mean that the factors – the fertility of the soil and the climate – contributing to the movement of the instability in area and yield in the opposite direction have become stronger in the second period.

Table 6. Components of Variance of Output (%)
(1955/56 — 1976/77 and 1977/78 — 1991/92)

State	$\frac{\text{Var}(\ln A_t)}{\text{Var}(\ln O_t)}$	$\frac{\text{Var}(\ln A_t)}{\text{Var}(\ln O_t)}$	$\frac{2\text{Cov}(\ln A_t, \ln Y_t)}{\text{Var}(\ln O_t)}$
Kerala:			
Period I	31.45	40.50	28.05
Period II	59.65	15.77	24.58
Karnataka:			
Period I	39.61	22.20	38.20
Period II	15.04	114.37	–29.41
Tamilnadu:			
Period I	62.68	46.05	–8.73
Period II	9.67	108.01	–17.68
All India:			
Period I	32.68	38.27	29.05
Period II	57.03	13.87	29.11

Despite the significant growth the rubber plantation industry in India is way back in the case of productivity compared to other producing countries as may be seen from the following Table.

Table 7. Productivity of Rubber in Major Countries
(Output per Hectare in 1989)

Malaysia	762
Thailand	675
India	656
Sri Lanka	556
China	414
Indonasia	404
Brazil	168

Note: Here the productivity is calculated as output per hectare of the total area under cultivation. Usually in the case of rubber, productivity is calculated as output per hectare of the tapable area. Since the available data at the international level does not permit such an exercise, this estimate is found to be sufficient for our purpose.

Conclusions & Recommendations

The analysis of the growth of output, area and productivity shows that output, area and yield have been on the increase. However the growth in the plantation industry has not been uniform across the board. The statewise estimations indicate that while in Karnataka and Tamilnadu area has an edge over yield, in the case of Kerala it is the yield which is the major force of growth. This may perhaps be due to the exhaustion of area suitable for rubber cultivation in Kerala and the innovativeness of the state in improving the technology. It has been found that Indian rubber plantation industry has been showing a trend towards stabilisation. The results show that area effect has been the major force behind the observed growth in the case of all the states except Kerala where the yield effect has dominated. We come to the conclusion that Kerala has attained yield stabilisation while Karnataka and Tamilnadu are subjected to wide fluctuations in the yield level. Thus, given the limited availability of land, and the existence of significant difference in productivity between Indian rubber plantation industry and the industry in other major producing countries, Kerala should concentrate on increasing the productivity while the other states may extend the area under cultivation.

Area effect has been the major force behind the observed growth in the case of all the states except Kerala where the yield effect has dominated.

Thus, from the instability analysis, we may come to the conclusion that in the case of Kerala, which accounts for more than 90 per cent of total production, the state has achieved yield stabilisation and whatever changes in output observed could be explained in terms of changes in area. As against this, regarding the new-comers of Karnataka and Tamilnadu, though there exists instability both in area and yield, the variability in the latter overwhelmingly outweighs the former that is, they have not attained yield stabilisation.

Kerala should concentrate on increasing the productivity while the other states may extend the area under cultivation.

References

Boyce, James K. (1987) *Agrarian Impasse in Bengal: Institutional Constraints to Technological Change*, Oxford University Press, Oxford.

MacBean, Alasdair I. (1966) *Export Instability and Economic Development*, George Allen & Unwin, London.

Mani, Sunil (1992) "Government Intervention in Commercial Crop Development: India's Natural Rubber Industry", *Economic and Political Weekly*, Vo. XXVII, No. 26, pp. A83-A92.

Oommen, Zacharia (1992) *Economics of Rubber Wood Industry in Kerala*, M.Phil. Thesis, Department of Applied Economics, Cochin University of Science and Technology, Cochin.

Pushpangadhan, K. (1988) "Agricultural Stagnation in Kerala: An Econometric Study of Tapioca", Working Paper No. 226, Centre for Development Studies, Trivandrum.

Rubber Board (n.d.) *Rubber and Its Cultivation*, Rubber Board, Kottayam.

Tharian, George K., Haridasan V. and Sreekumar B. (1988) "Role of Government and Structural changes in Rubber Plantations Industry" *Economic and Political Weekly*, Vol. XXIII, No. 26, pp. M158-M166. □

Life time Employment

I cannot understand why there is anything good in laying off people. If management takes the risk and responsibility of hiring personnel, then it is management's ongoing responsibility to keep them employed. The employee does not have the prime responsibility in the decision, so when a recession comes, why should the employee have to suffer for the management decision of hire him ?

– Akio Morita

The concept of life time employment may mean two things in a Japanese Company: either to retain a rather small workforce and to generate more output during dull periods; or to maintain a double structure consisting of the core which works on the principle of permanent relations and the peripheral which serves as a shock absorber.

– Ryushi Iwata

Productivity in Indian Steel Industry: International Comparisons

L.K. Singhal

Various productivity indices for Indian integrated steel plants have been compared with several leading companies in different countries. While there is discernable improvement in most productivity indices of Indian steel plants during recent years, the levels attained are nowhere near the industry's best with the exception of material value productivity in which case Indian plants are quite favourably placed. The paper discuses various measures which could help generate more revenue, reduce inputs, increase capital turnover, improve capital and labour value productivities and further enhance material value productivity to tone up the competitive edge of Indian steel.

L.K. Singhal is Director (Technology), Metallurgical & Engineering consultants India Ltd., Ranchi-834002.

Recent years have witnessed remarkable improvements in productivity all over the globe. The steel industry has also achieved significant success on these lines. There are various methods for measuring the productivity of individual firms and countries. One of the models which has been used by Lin and Wli (1988) for a similar study in steel industry has the following measures:

$$\text{Total Value Productivity (TVP)} = \frac{\text{Total Revenue}}{\text{Total Input}}$$

$$\text{Labour Value Productivity (LVP)} = \frac{\text{Total Revenue}}{\text{Total Labour Input}}$$

$$\text{Capital Value Productivity (CVP)} = \frac{\text{Total Revenue}}{\text{Total Capital Input}}$$

$$\text{Material Value Productivity (MVP)} = \frac{\text{Total Revenue}}{\text{Total Material Input}}$$

$$\text{Employee Productivity (EP)} = \frac{\text{Annual steel production}}{\text{Average no. of employees}}$$

The above indices for leading integrated steel companies in USA, Canada, Europe, Japan, and South Korea have therefore been compared with those in India. The following ratios have also been evaluated which are good measures of efficiency and influence profitability and competitiveness:

- Gross Working Capital Efficiency
- Net Working Capital Efficiency
- Stock to Total Revenue

This approach highlights the contributions of various factors of production thereby throwing light on avenues for improvement. The full competitive potential of Indian

firms will be realised only when their productivity indicators match the highest levels attained by the industry.

The full competitive potentital of Indian firms will be realised only when their productivity indicators match the highest levels attained by the industry.

Productivity Indices

The data for USX Corpn. USA; Stelco Inc., Canada; British Steel, UK; Thyssen Stahl, Germany; Nippon Steel, Japan; POSCO, South Korea and SAIL and TISCO of India are given in Annexures I to VIII. The productivity indices for these organisations are compared in tables 1-7 based on data from La Chambre des Cartes (1990) and Statistics for Iron and Steel Industry in India (1992). The Average value of the ratios for the period shown in these annexures are indicated in table 8. The Capital value productivity of Thyssen Stahl far exceeds the figures for SAIL and TISCO. The values for SAIL and TISCO are close to Stelco, USX, Nippon, and British Steel. The high CVP of Thyssen emanates from relatively low capital base and limited investment. From 1983-84 to 1987-88, the fixed assets increased by only 10 per cent. Though there is continuous investment on capital account, the amounts

Table 1: Capital Value Productivity

	83-84	84-85	85-86	86-87	87-88	88-89	89-90	90-91	91-92
British Steel	1.28	1.35	1.13	0.94	1.10	1.19			
Thyssen Steel	1.75	1.88	1.85	1.70	2.24				
Nippon Steel	1.01	1.10	1.03	0.84	0.89	1.06			
USX*	1.03	1.16	1.19	0.72	0.83	1.00			
Stelco*	0.84	0.97	0.98	0.95	1.07	1.13			
POSCO*			0.70	0.59	0.65	0.76			
TISCO				1.59	1.67	1.54	1.39	1.46	1.38
SAIL			0.91	0.81	0.80	1.03	0.99	1.03	

Figures for calendar year i.e. 85 instead of 85-86 instead of 86-87 etc.

Table 2 : Labour Value Productivity

	83-84	84-85	85-86	86-87	87-88	88-89	89-90	90-91	91-92
British Steel	3.75	4.15	4.31	4.48	5.02	5.44			
Thyssen Steel	3.69	3.88	3.52	3.01	3.58	-			
Nippon Steel	6.16	6.63	5.85	5.24	5.11	5.30			
USX*	4.28	5.16	5.19	5.18	5.64	6.77			
Stelco	2.60	2.76	2.94	2.99	3.10	3.24			
POSCO			18.56	17.89	18.19	18.92			
TISCO				5.34	4.87	5.15	5.14	5.02	5.53
SAIL			7.52	6.45	6.33	7.48	7.02	7.37	

Table 3: Material Value Productivity

	83-84	84-85	85-86	86-87	87-88	88-89	89-90	90-91	91-92
British Steel	1.46	1.42	1.46	1.56	1.67	1.68			
Thyssen Steel	1.59	1.58	1.68	1.73	1.73				
Nippon Steel	1.39	1.39	1.37	1.35	1.53	1.57			
USX*	1.55	1.61	1.55	1.48	1.54	1.53			
Stelco*	1.76	1.79	1.79	1.73	1.72	1.74			
POSCO*			1.77	1.76	1.88	2.31			
TISCO				3.85	4.66	4.34	4.38	3.00	2.78
SAiL			1.68	1.60	1.67	1.72	1.66	1.73	

* Figures for calendar year

Table 4: Total Value Productivity

	83-84	84-85	85-86	86-87	87-88	88-89	89-90	90-91	91-92
British Steel	0.95	0.96	1.01	1.06	1.11	1.16			
Thyssen Steel	1.03	1.04	1.02	0.97	1.86				
Nippon Steel	1.00	1.03	1.00	0.95	1.03	1.08			
USX*	1.00	1.06	1.04	0.95	1.01	1.06			
Stelco*	0.97	1.01	1.04	1.02	1.03	1.04			
POSCO			1.11	1.12	1.08	10.25			
TISCO				1.03	1.03	1.06	1.01	1.07	1.07
SAIL			1.02	0.96	0.98	1.02	0.98	1.08	

* Figures for calendar year

Table 5: Employee Productivity

Year	86-87	87-88	88-89	89-90	90-91
TISCO*	74	74	74	74	72
BSP*	61	66	82	90	98
BSL*	68	77	85	82	87
DSP*	39	41	42	42	45
RSP*	44	47	51	51	56
IISCO*	29	31	29	23	24
British Steel#	207	246	266	NA	259+
Thyssen Steel#	229	273	NA	NA	288+
Nippon Steel#	402	445	480	NA	529+
Year	86	87	88	89	90
Stelco#	215	239	250	NA	278+
USX#	197	250	473	NA	NA
POSCO#	501	583	654	NA	654+

* Statistics for Iron and Steel industry in India 1992 SAIL Parliament & Coordination Section.
\# *La chambre des cartes June 89* ; + For 1990 Data from Aus consultants

Table 6: Net Working Capital Turnover

	83-84	84-85	85-86	86-87	87-88	88-89	89-90	90-91	91-92
British Steel	3.97	3.79	3.32	2.88	3.22	3.16			
Thyssen Steel	4.08	4.42	5.60	5.56	10.74				
Nippon Steel	4.20	4.59	3.07	2.41	2.63	3.24			
USX*	8.71	11.24	14.87	3.03	5.56	6.55			
Stelco*	2.91	2.60	2.63	2.92	4.47	4.55			
POSCO*			2.84	4.16	3.45	4.39			
TISCO				7.33	7.97	8.88	5.16	6.20	5.61
SAIL		3.60	3.02	2.82	3.80	3.62	3.71		

* Figures for calendar year

Table 7: Stock to Total Revenue

	83-84	84-85	85-86	86-87	87-88	88-89	89-90	90-91	91-92
British Steel	0.26	0.25	0.24	0.25	0.22	0.21			
Thyssen Steel	0.16	0.15	0.15	0.15	0.11	-			
Nippon Steel	0.28	0.27	0.28	0.30	0.29	0.25			
USX*	0.13	0.12	0.11	0.10	0.10	0.10			
Stelco*	0.33	0.31	0.30	0.28	0.22	0.24			
POSCO*			0.20	0.20	0.20	0.17			
TISCO							-	0.30	0.31
SAIL			0.38	0.45	0.42	0.39	0.42	0.48	

* Figures for calendar year

are small and evidently better managed. Apart from controlling accretion to net fixed assets, we also see how dramatically Thyssen have brought down the working capital year after year. The net working capital turnover increased from 4.08 in 83-84 to 10.74 in 87-88. Both in USX and Thyssen, the stock, as a fraction of total revenue, has been low. Additionally, corporations such as USX, Stelco, Thyssen and British Steel have brought down stock levels year after year. Comparatively, stock levels in Indian companies have been on the higher side indicating a way to improve the capital value productivity. The higher CVP of TISCO as compared to SAIL is interestingly due to the higher value addition in the products in case of former.

Labour Value Productivity, which is inversely proportional to labour cost per tonne of steel, is highest in case of POSCO followed by SAIL. A five year average gives a figure of 7.01 for SAIL whereas Nippon Steel comes next with 5.69 and TISCO follows with 5.17. A very high output per employee, coupled with low wage levels have led to star studded performance by POSCO. While LVP of Indian Plants is high, the employee productivity in TISCO and SAIL plants is only a small fraction of the values achieved in modern plants abroad (table 9) highlighting the fact that the apparently high labour value productivity in India is not derived on account of efficiency but rather due to low wages and, that a very high potential exists for further enhancing labour value productivity multi-fold. Table 9 indicates how European and American companies have been steadily improving Labour Value Productivity and Employee Productivity over a long period. A similar approach is warranted in India to forge ahead of other countries on LVP. Though LVP values are high for Japanese companies and employee productivity has been increasing due to the appreciation of Yen against Dollar, LVP indices have not improved. While it is heartening to note that the employee productivity in most SAIL units is steadily increasing during the last 5 years, an accelerated pace is warranted to bridge the widening gap with the developed countries.

European and American companies have been steadily improving Labour Value Productivity and Employee Productivity over a long period. A similar approach is warranted in India to forge ahead.

Table 8: Geometric Mean of Productivity Indicators

Parameter/Company	USX	Stelco	British Steel	Thyssen Steel	Nippon Steel	POSCO	TISCO	SAIL
Capital Value Productivity	0.97	0.99	1.16	1.87	0.98	0.67	1.50	0.92
Labour Value Productivity	5.32	2.92	4.49	3.52	5.69	18.39	5.17	7.01
Material Value Productivity	1.54	1.76	1.54	1.64	1.43	1.92	3.76	1.68
Total Value Productivity	1.02	1.02	1.04	1.02	1.01	1.14	1.04	0.99
Stock Ratio	0.11	0.28	0.24	0.14	0.28	0.19	0.38	0.41
Net working capital turnover	7.37	3.25	3.37	5.70	3.27	3.66	6.73	3.40

Table 9: Labour Value Productivity & Employee Productivity

Year	Sales $/tonnes	Labour cost $/tonne	LVP	Tonnes Produced Per Workers (EP)
		USA—20 Companies		
1975	385.53	157.1	2.54	179.2
1980	570.3	224.9	2.53	198.1
1985	536.2	162.1	3.30	318.1
1990	558.3	128.5	4.34	455.4
		JAPAN—8 Companies		
1975	250.5	33.4	7.50	423.9
1980	459.7	60.5	7.60	442.6
1985	425.8	70.7	6.02	461.5
1990	629.0	86.5	7.27	673.7
		E.E.C.—15 Companies		
1975	330.8	106.9	3.09	144.5
1980	508.1	150.7	3.37	184.5
1985	371.4	90.5	4.10	230.7
1990	579.2	125.9	4.60	283.4

be upgraded to higher capacities by incorporation of limited additional facilities. For example, installation of additional burners in the furnace of Annealing Pickling Line could result in increase of its capacity, thus obviating the need for another Annealing and Pickling line in Salem Steel while doubling its stainless steel production. Similarly, for a merchant mill in Cherpovets, which is similar to BSP mill, a very substantial increase in capacity could be achieved by the addition of a reheating furnace. There are innumerable such possibilities in steel plants which should be explored before opting for installation of new units.

It is desirable to augment the capacities of existing units before creating new assets.

Technological improvement measures which result in reduction in overall capital expenditure in due course, should also be accorded high priority. For example, coal dust injection in Blast Furnace can help curtail coke requirement in the plant, thus eliminating the need for rebuilding some of the coke ovens, thereby saving enormous capital expenditure in the long run. As seen earlier from data of many progressive companies, tremendous importance is being attached to minimise the money locked up in inventories, work-in-process and finished stocks.

Reducing Work-in-Process

Hayes & Clark (1986) have found that the effect of cutting Work-in-Process (WIP) for given level of output on productivity was much greater than could be explained by reduction in working capital. To be successful, a programme for reducing WIP must attack the reasons for its being there in the first place: erratic yields, material defects, unreliable equipment, ever-changing production schedule etc. By setting up adequate measures of performance, building a system for planning monitoring and control and ensuring careful process control, nurturing in-depth technical competence, we can inch towards reduced WIP, stocks and improved working capital turnover.

Investing Capital Judiciously

Although SAIL and TISCO plants are not very modern, the financial charges per tonne of steel are quite high and exceed the values for plants in Europe and USA. The capital outlays during the last 6 years have also been high as seen from table 13. New investments have to be carefully planned and managed, otherwise they may blunt the competitive edge. Competitiveness Policy Council, Washington (1992) has pointed out that the chief measure of competitiveness is not only the nations ability to meet the test of global markets and achieve higher living standards; in addition the economic growth must be domestically financed and sustainable over the long term. It is therefore vital that the investment should generate surpluses to fuel further growth. It is obviously desirable to prioritise and do things that ought to be done first, things that take less time to show results and are much less expensive.

The investment should generate surpluses to fuel further growth.

Since in view of favourable raw materials factors and low per-capita availability, Indian Steel Industry is poised for rapid expansion, the following two pronged approach merits serious consideration:

- Modernising existing assets with modest inputs for incremental improvements.
- Opting for revolutionary cost effective technologies for expansion of units and greenfield sites.

In this manner one could extend the life of depreciated existing assets and continue to derive benefits from their low financial costs and also reap the full benefit of higher material value productivity and employee productivity from new units.

Table 13: Capital outlay per tonne produced dollars per metric tonne of crude steel

	1986	1987	1988	1989	1990	1991
United States	12	14	20	26	28	30
Japan	42	35	37	48	60	74
European Community	34	34	25	26	42	30
Other Western Europe	34	38	40	44	53	69
Canada	49	37	26	39	33	25
Latin America	27	28	22	29	33	40
Republic of Korea	151	102	139	164	151	149
India	99	108	87	91	90	63
Other Asia & Africa*	54	86	45	117	96	63

* Includes Taiwan, Australia, New Zealand, South Africa
WSD March 92, 137.

Yield Improvement

Strict adherence to technological norms and many low cost technological inputs can improve yield significantly. Duk-Hyun Baik (1986) has described the various measures adopted in POSCO to prevent losses during reheating and rolling resulting in a 3 to 6 per cent gain in yield for different products. Fig. 3 shows how companies in various countries have been improving product yield over the years. Greater emphasis on a large number of small quality improvement projects, use of statistical quality control and process modelling tools have enabled companies to make significant gains on yield during the last decade. While yield can be increased by capital intensive measures such as larger converter size, introduction of continuous casting, sequence casting, heavier slab/coil weights, the investments involved are large. Low cost measures such as bottom poured ingots, recessed bottom ingots and manufacture of rimming steel also lead to substantive improvement in yield. Practice of static/dynamic converter control, hot charging, bite & back of double top rolling also minimise loss of valuable material. In view of paucity of capital, greater focus is needed on such options.

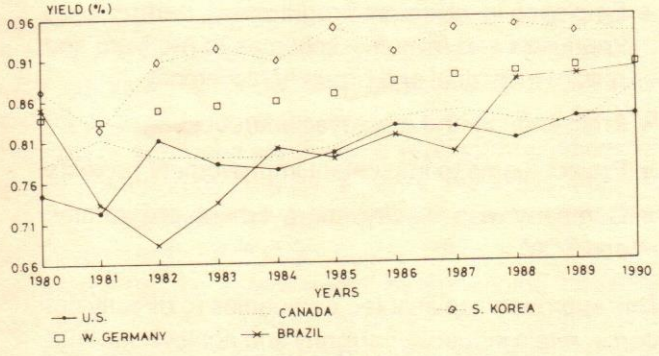

Fig. 3

Development of Value Added Products

The plants must strive for maximum value addition in their products. Often intermediate products such as billets and hot rolled coils find ready outlets leading to underutilisation of secondary rolling mills and cold finishing units. The plants should also seek to maximise production of special steels from existing facilities. Many secondary steel making facilities such as RH, VAD and VOD in Indian plants are currently not harnessed to the same extent as in plants abroad.

Enhancing Material Value Productivity

There is very significant scope for production in the quantity of raw material consumption in Indian steel plants including iron ore, coal and limestone etc. Table 14 shows how various countries have reduced specific coke consumption rates in blast furnaces from 1980. The consumption of air, water, refractories etc. is also relatively very high in Indian plants and further impetus to conservation of all raw materials is warranted.

Table 14: Coke consumption in Blast Furnace/thm

	1980	1985	1987	1988	1989
U.S.A	570		529	527	522
U.K.	588	557	499	470	473
France	520	509	482	451	447
Italy	460	478	467	468	443
Germany	515	531	458	444	442
	1980-81	1985-86	1987-88	1988-89	1989-90
BSP	837	723	721	682	692
BSL	777	728	679	666	664
TISCO		793	744	716	714

Recycling of Wastes

During the production of iron and steel, various waste oxides are generated. These include dust from raw material yard, sintering plant and blast furnace sludge, steel making dust and mill scale etc. These materials which amount to nearly 10 per cent of steel production by weight, contain useful resources such as iron oxide, lime and carbon (International Iron and Steel Institute, 1987). Most of the fines can be utilised by suitable agglomeration followed by further processing. Similarly production of lime from limestone generates substantial amount of fines. By converting them into lime briquettes, the product is even superior to lime lumps for use in steel making. In this manner, conservation of several input materials can be effectively practised.

Wealth from Waste

Each year the steel industry produces about 400 million tonnes of by-products, solid wastes and sludge. Based upon the source, waste products from steelworks can be classified as:

- Blast Furnace slag
- BF dust and sludge
- Steel making slag
- BOF, OH & EAF sludge and dust
- Continuous casting and rolling sludge
- Mill scale
- Used oils and grease
- Refractory wastes including bricks
- Coke oven by-products

British Steel PLC. England

Sl. No.	Particulars	Amount in Million Pounds					
		1983-84	1984-85	1985-86	1986-87	1987-88	1988-89
BASIC DATA:							
1	Total Product	3,429	3,778	3,830	3,380	4,193	5,009
	Total Revenue	3,429	3,778	3,830	3,380	4,193	5,009
2	Cost of Sales (Total Material cost)	2,343	2,661	2,616	2,162	2,508	2,985
3	Total Labour Cost	915	910	889	754	836	920
	Depreciation	86	92	112	129	161	198
	Provisions	15	12	1	-	-	-
	Other Operating Costs	207	202	121	149	266	250
	Net Financial Charges	52	57	37	5	(8)	(42)
	Total Input	3,618	3,934	3,776	3,199	3,763	4,311
4	Operating Profit	(137)	(99)	91	186	422	656
5	Net Fixed Assets	1,809	1,805	2,235	2,414	2,506	23,630
6	Current Assets	947	974	915	1,007	1,189	1,819
7	Stocks	905	960	929	860	926	1,074
8	Current Liabilities	988	936	690	694	811	1,310
9	Net Working Capital	864	998	1,154	1,173	1.304	1,583
10	Total Capital Input	2,673	2,803	3,389	3,587	3,810	4,213
11	Total Steel Productivity (QTY '000 T)	13,400	13,000	14,000	11,700	14,700	15,400
RATIOS:							
(a)	Total Value Productivity	0.95	0.96	1.01	1.06	1.11	1.16
(b)	Labour Value Productivity	3.75	4.15	4.31	4.48	5.02	5.44
(c)	Capital Value Productivity	1.28	1.35	1.13	0.94	1.10	1.10
(d)	Material Value Productivity	1.46	1.42	1.46	1.56	1.67	1.68
(e)	Gross Working Capital Turnover	1.85	1.95	2.08	1.81	1.98	1.73
(f)	Net Working Capital Turnover	3.97	3.79	3.32	2.88	3.22	3.16
(g)	Stock to Total Revenue	0.26	0.25	0.24	0.25	0.22	0.21
(h)	Profitability Index	– 4.00%	–2.62%	2.38%	5.50%	10.06%	13.10%

Thyssen Stahl AG. Germany

Sl. No.	Particulars	Amount in Million DM				
		1983-84	1984-85	1985-86	1986-87	1987-88
BASIC DATA:						
1	Total Product	9,723	10,560	9,654	8,084	9,774
	Total Revenue	9,703	10,538	9,633	8,064	9,727
2	Cost of Sales (Total Material cost)	6,098	6,686	6,002	4,663	5,610
3	Total Labour Cost	2,633	2,718	2,738	2,679	2,715
	Depreciation	611	674	630	855	787
	Provisions					
	Other Operating Costs			1		
	Net Financial Charges	116	97	91	81	69
	Total Input	9,458	10,175	9,462	8,278	9,181
4	Operating Profit	361	460	262	(133)	615
5	Net Fixed Assets	3,168	3,223	3,496	3,291	3,438
6	Current Assets	1,990	2,127	1,636	1,355	1,214
7	Stocks	1,567	1,609	1,427	1,217	1,086
8	Current Liabilities	1,180	1,350	1,342	1,121	1,394
9	Net Working Capital	2,377	2,386	1,721	1,451	906
10	Total Capital Input	5,545	5,609	5,217	4,742	4,344
11	Total Steel Productivity (QTY '000 T)	10,715	11,272	10,878	10,138	10,826
RATIOS:						
(a)	Total Value Productivity	1.03	1.04	1.02	0.97	1.06
(b)	Labour Value Productivity	3.69	3.88	3.52	3.01	3.58
(c)	Capital Value Productivity	1.75	1.88	1.85	1.70	2.24
(d)	Material Value Productivity	1.59	1.58	1.60	1.73	1.73
(e)	Gross Working Capital Turnover	2.73	2.82	3.14	3.14	4.23
(f)	Net Working Capital Turnover	4.08	4.42	5.60	5.56	10.74
(g)	Stock to Total Revenue	0.16	0.15	0.15	0.15	0.11
(h)	Profitability Index	3.72%	4.37%	2.72%	-1.65%	6.32%

Nippon Steel Corporation, Japan

Sl. No.	Particulars	Amount in Billion Yens					
		1983-84	1984-85	1985-86	1986-87	1987-88	1988-89
BASIC DATA:							
1	Total Product	2,660	2,860	2,685	2,179	2,147	2,385
	Total Revenue	2,616	2,805	2,685	2,179	2,147	2,385
2	Cost of Sales (Total Material cost)	1,887	2,011	1,953	1,613	1,403	1,521
3	Total Labour Cost	425	423	459	416	420	450
	Depreciation	192	188	173	169	198	181
	Provisions						
	Other Operating Costs						
	Net Financial Charges	101	95	102	87	71	62
	Total Input	2,605	2,717	2,687	2,285	2,092	2,214
4	Operating Profit	112	183	100	(19)	126	233
5	Net Fixed Assets	1,973	1,943	1,730	1,684	1,602	1,514
6	Current Assets	935	944	1,089	1,005	929	898
7	Stocks	741	759	740	643	616	607
8	Current Liabilities	1,053	1,092	955	745	728	769
9	Net Working Capital	623	611	874	903	817	736
10	Total Capital Input	2,596	2,554	2,604	2,587	2,419	2,250
11	Total Steel Productivity (QTY '000 T)	27,727	29,596	27,981	25,567	27,157	28,217
RATIOS:							
(a)	Total Value Productivity	1.00	1.03	1.00	0.95	1.03	1.08
(b)	Labour Value Productivity	6.16	6.63	5.85	5.24	5.11	5.30
(c)	Capital Value Productivity	1.01	1.10	1.03	0.84	0.89	1.06
(d)	Material Value Productivity	1.39	1.39	1.37	1.35	1.53	1.57
(e)	Gross Working Capital Turnover	1.56	1.65	1.47	1.32	1.39	1.58
(f)	Net Working Capital Turnover	4.20	4.59	3.07	2.41	2.63	3.24
(g)	Stock to Total Revenue	0.28	0.27	0.28	0.30	0.29	0.25
(h)	Profitability Index	4.28%	6.52%	3.72%	–0.87%	5.87%	9.77%

USX, USA

Sl. No.	Particulars	Amount in Million US $					
		1983-84	1984-85	1985-86	1986-87	1987-88	1988-89
BASIC DATA:							
1	Total Product	17,646	19,486	19,273	14,714	14,901	17,100
	Total Revenue	16,314	18,061	17,919	13,472	13,543	15,573
2	Cost of Sales (Total Material cost)	10,519	11,197	11,551	9,087	8,774	10,172
3	Total Labour Cost	3,810	3,500	3,450	2,600	2,400	2,300
	Depreciation	1,104	1,241	1,294	1,559	1,332	1,369
	Provisions						
	Other Operating Costs	195	226	176	179	112	197
	Net Financial Charges	746	905	753	786	751	632
	Total Input	16,374	17,069	17,224	14,211	13,369	14,670
4	Operating Profit	686	1,897	1,448	47	925	1,535
5	Net Fixed Assets	14,010	13,954	13,825	14,392	13,795	13,135
6	Current Assets	3,205	2,871	2,560	6,100	4,389	4,825
7	Stocks	2,099	2,164	2,061	1,331	1,373	1,514
8	Current Liabilities	3,432	3,428	3,416	2,989	3,326	3,960
9	Net Working Capital	1,872	1,607	1,205	4,442	2,436	2,379
10	Total Capital Input	15,882	15,561	15,030	18,834	16	231
11	Total Steel Productivity (QTY '000 T)	13,400	13,700	15,100	8,700	10,400	14,100
RATIOS:							
(a)	Total Value Productivity	1.00	1.06	1.04	0.95	1.01	1.06
(b)	Labour Value Productivity	4.28	5.16	5.19	5.18	5.64	6.77
(c)	Capital Value Productivity	1.03	1.16	1.19	0.72	0.83	1.00
(d)	Material Value Productivity	1.55	1.61	1.55	1.48	1.54	1.53
(e)	Gross Working Capital Turnover	3.08	3.59	3.88	1.81	2.35	2.46
(f)	Net Working Capital Turnover	8.71	11.24	14.87	3.03	5.56	6.55
(g)	Stock to Total Revenue	0.13	0.12	0.12	0.10	0.10	0.10
(h)	Profitability Index	4.20%	10.50%	8.08%	0.35%	6.83%	9.86%

Pohang Iron & Steel Co. Korea.

Sl. No.	Particulars	Amount in Billion Yens			
		1984	1985	1986	1987
BASIC DATA:					
1	Total Product	2,048	2,242	2,919	3,701
	Total Revenue	2,042	2,236	2,910	3,690
2	Cost of Sales (Total Material cost)	1,153	1,273	1,549	1,597
3	Total Labour Cost	110	125	160	195
	Depreciation	476	438	721	1,103
	Provisions	28	30	40	45
	Other Operating Costs				
	Net Financial Charges	66	126	212	5
	Total Input	1,833	1,992	2,682	2,945
4	Operating Profit	275	370	440	750
5	Net Fixed Assets	2,184	3,255	3,634	3,998
6	Current Assets	732	785	915	934
7	Stocks	411	440	590	630
8	Current Liabilities	423	688	662	723
9	Net Working Capital	720	537	843	841
10	Total Capital Input	2,904	3,792	4,477	4,839
11	Total Steel Productivity (QTY '000 T)	9,280	9,530	11,340	13,080
RATIOS:					
(a)	Total Value Productivity	1.11	1.12	1.09	1.25
(b)	Labour Value Productivity	18.56	17.89	18.19	18.92
(c)	Capital Value Productivity	0.70	0.59	0.65	0.76
(d)	Material Value Productivity	1.77	1.76	1.88	2.31
(e)	Gross Working Capital Turnover	1.79	1.83	1.93	2.36
(f)	Net Working Capital Turnover	2.84	4.16	3.45	4.39
(g)	Stock to Total Revenue	0.20	0.20	0.20	0.17
(h)	Profitability Index	13.47%	16.55%	15.1%	20.33%

Tisco, India

Sl. No.	Particulars	Amount in Rs. Crores					
		1986-87	1987-88	1988-89	1989-90	1990-91	1991-92
BASIC DATA:							
1	Total Product	1,372	1,479	1,796	2,042	2,250	2,916
	Total Revenue	1,197	1,303	1,599	1,820	1,995	2,638
2	Cost of Sales (Total Material cost)	311	280	368	416	656	951
3	Total Labour Cost	224	268	311	354	397	477
	Depreciation	58	74	94	119	137	165
	Provisions					1	3
	Other Operating Costs	511	578	671	797	635	832
	Net Financial Charges	63	67	67	117	24	39
	Total Input	1,167	1,267	1,512	1,803	1,859	2,467
4	Operating Profit	94	104	155	134	159	210
5	Net Fixed Assets	587	619	861	958	1,041	1,441
6	Current Assets					608	831
7	Stocks					597	818
8	Current Liabilities					883	1,179
9	Net Working Capital	163	164	180	353	322	470
10	Total Capital Input	751	782	1,041	1,310	1,363	1,911
11	Total Steel Productivity (QTY '000 T)					1,901	1,978
RATIOS:							
(a)	Total Value Productivity	1.03	1.03	1.06	1.01	1.07	1.07
(b)	Labour Value Productivity	5.34	4.87	5.15	5.14	5.02	5.53
(c)	Capital Value Productivity	1.59	1.67	1.54	1.39	1.46	1.38
(d)	Material Value Productivity	3.85	4.66	4.34	4.38	3.00	2.78
(e)	Gross Working Capital Turnover					1.66	1.60
(f)	Net Working Capital Turnover	7.33	7.97	8.88	5.16	6.20	5.61
(g)	Stock to Total Revenue					29.92%	31.01%
(h)	Profitability Index	7.83%	7.95%	9.71%	7.37%	7.98%	7.95%

*Saleable Steel

Data for 86-87 to 89-90 is incomplete for finer analysis. However, the RATIOS are consistent excepting Material Value Productivity.

SAIL, India

Sl. No.	Particulars	Amount in Rs. Crores					
		1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
BASIC DATA:							
1	Total Product	4,593	4,465	5,105	6,994	7,616	8,443
	Total Revenue	4,091	3,949	4,526	6,178	6,644	7,423
2	Cost of Sales (Total Material cost)	2,428	2,465	2,711	3,582	3,995	4,282
3	Total Labour Cost	544	612	715	826	946	1,007
	Depreciation	322	322	385	478	536	607
	Provisions						
	Other Operating Costs	484	521	634	902	985	1,176
	Net Financial Charges	214	206	197	276	303	355
	Total Input	3,992	4,126	4,641	6,064	6,765	7,427
4	Operating Profit	313	29	81	390	182	351
5	Net Fixed Assets	3,362	3,560	4,051	4,362	4,883	5,222
6	Current Assets	938	978	1,157	1,371	1,372	1,690
7	Stocks	1,573	1,766	1,922	2,427	2,784	2,981
8	Current Liabilities	1,374	1,435	1,473	2,174	2,322	2,670
9	Net Working Capital	1,137	1,309	1,606	1,624	1,834	2,001
10	Total Capital Input	4,499	4,869	5,657	5,986	6,717	7,223
11	Total Steel Productivity (QTY '000 T)	6,400	6,308	6,940	8,011	7,928	8,438
RATIOS:							
(a)	Total Value Productivity	1.02	0.96	0.98	1.02	0.98	1.00
(b)	Labour Value Productivity	7.52	6.45	6.33	7.48	7.02	7.37
(c)	Capital Value Productivity	0.91	0.81	0.80	1.03	0.99	1.03
(d)	Material Value Productivity	1.68	1.60	1.67	1.72	1.66	1.73
(e)	Gross Working Capital Turnover	1.63	1.44	1.47	1.63	1.60	1.59
(f)	Net Working Capital Turnover	3.60	3.02	2.82	3.80	3.62	3.71
(g)	Stock to Total Revenue	0.38	0.45	0.42	0.39	0.42	0.40
(h)	Profitability Index	7.65%	0.75%	1.79%	6.31%	2.74%	4.73%

Energy Productivity in Indian Manufacturing Industries (1973-88)

NPC Research Division

In an earlier issue (Productivity 32,1) we arrived at energy productivity ratios for Indian manufacturing industries during the period 1973-86. In the present study, we attempt to update the information for 1987 and 1988 for which the basic data are now available from the Annual Survey of Industries. As in the case of the previous study, energy productivity here is defined as output per unit of energy consumed, both the output and energy input measured at constant base year prices. While in the previous study the variables were measured at 1970-71 constant base year prices, in the present study these are expressed at 1981-82 constant base year prices. The output is measured in terms of products and byproducts as given in the Annual Survey of Industries (ASI). The series at 1970-71 prices has been converted to 1981-82 prices, based on the Index Numbers of Wholesale Prices with 1981-82 base.

Energy input has been measured in terms of cost of power and fuel deflated to 1981-82 base prices. For deflation purposes, the energy price index for each industrial category has been computed by a weighted combination of the Index Numbers of Wholesale Prices of electricity, motor spirit, diesel oil, coal, furnace oil and others; the weights being their shares in total cost of fuel at current prices in the case of each of 46 industry groups. These shares are arrived at based on the energy composition of each industry group during the year 1978-79, the latest year for which the detailed information is available from the Annual Survey of Industries. (Table 1). However, of the 46 Industry Groups covered by the previous study, two categories viz., locomotive Parts (371) and Railway Wagons (372) are excluded by the present study for want of wholesale price indices.

Table 2 provides

(i) Share of energy inputs at current prices in the total value of inputs at current prices (%)

(ii) Output at 1981-82 prices per unit of energy input at 1981-82 prices

(iii) Number of factories covered

Table 1. Fuel Cost Weightages (%) (1978-79)

Industry code no.	Coal	Motor Spirit	Diesel Oil	Furnace Oil	Electri-city	Others
20-21	13.42	3.53	8.06	13.29	36.98	24.72
206	9.05	3.97	4.23	11.93	22.35	48.47
210	29.13	1.55	1.25	10.88	48.05	9.14
22	27.16	9.07	7.81	16.96	23.09	15.91
23	17.07	1.22	1.54	10.01	56.63	13.53
24	14.79	2.79	3.65	14.23	42.32	22.22
25	14.80	2.42	4.77	0.80	66.07	11.13
26	6.13	16.20	4.97	14.08	43.66	14.96
27	6.80	11.11	18.47	4.62	40.85	18.15
28	27.85	2.72	1.66	15.83	42.55	9.39
280	31.08	1.18	1.42	17.79	40.34	8.19
29	5.53	11.21	8.36	9.77	52.95	12.18
30	5.45	2.89	2.66	13.65	44.52	30.83
31	9.32	1.56	2.47	23.12	45.88	17.65
310	12.97	1.11	4.05	19.14	49.57	13.16
311	1.86	1.44	1.10	12.21	58.74	24.65
312	9.37	0.29	0.19	28.67	41.41	20.07
313	0.00	4.62	2.54	41.98	43.65	7.20
32	8.53	2.00	2.97	20.15	47.66	18.69
320	7.62	1.89	2.02	19.18	44.89	24.40
321	5.00	1.01	1.97	18.10	45.00	28.92
324	1.96	1.22	1.40	10.20	55.56	29.66
33	23.26	0.72	2.07	11.37	33.08	29.51
330	1.97	9.41	3.90	10.07	64.29	10.36
331	12.88	2.06	5.89	16.23	33.25	29.69
332	0.69	0.32	0.56	3.04	83.33	12.06
333	5.43	1.21	11.54	33.97	45.35	2.50
335	3.94	0.46	0.78	16.38	67.78	10.66
336	0.10	0.56	1.73	3.54	87.42	6.65
34	4.41	7.51	6.01	14.37	44.52	23.18
35	9.27	6.75	8.71	5.80	42.52	26.95
350	3.25	4.96	6.91	4.01	38.10	42.77
352	0.00	23.00	7.78	0.00	59.45	9.77
353	7.43	11.52	3.94	15.35	57.66	4.10
354	9.77	42.74	0.49	2.32	30.89	13.80
355	0.16	7.81	7.24	1.36	43.99	39.44
357	0.48	5.53	4.22	12.40	48.17	29.20
36	6.24	9.56	7.30	19.00	50.05	7.84
360	4.95	5.58	7.79	4.92	56.72	20.24
37	14.50	3.62	4.98	14.25	42.35	20.30
374	1.26	4.50	9.58	11.80	44.66	28.19
375	0.31	5.95	7.28	10.79	44.85	30.81
376	2.28	4.97	8.82	22.53	39.24	22.16
38	2.22	13.63	4.78	8.95	58.88	11.54

Table 2. Energy Productivity Ratios in Indian Manufacturing Industries

	Food Product (20-21)			Refining of Sugar (206)			Hydrogenated Oils, Vanaspati (210)			Beverages, tobacco & tobacco products (22)		
	Share of energy in total input	Energy productivity ratio %	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)
1973	1.96	33.2	13509	2.03	44.6	261	1.72	35.7	65	1.52	43.1	2357
1974	2.23	33.7	13454	2.39	45.2	251	1.88	35.1	71	2.12	37.3	2080
1975	2.52	34.3	14126	2.45	47.5	243	2.27	43.3	75	2.22	32.3	2880
1976	2.76	32.5	15306	3.01	41.6	261	2.58	39.1	79	2.16	36.3	6398
1977	2.60	36.2	15783	2.90	46.7	288	2.01	39.9	69	2.04	34.3	7307
1978	2.66	43.6	16310	2.86	53.1	286	2.60	37.7	69	2.35	33.2	8240
1979	2.90	34.5	16840	3.24	47.0	293	3.02	33.0	83	2.86	30.5	9629
1980	3.25	25.3	17067	3.88	33.4	304	3.31	29.8	82	3.23	29.3	8901
1981	3.24	38.9	18351	2.77	52.3	296	3.44	30.0	76	3.43	31.3	9568
1982	3.17	36.7	17111	2.44	66.5	308	3.32	32.9	90	3.33	34.4	8486
1983	3.42	36.1	17523	2.73	69.8	318	3.82	29.0	109	3.79	37.0	8188
1984	3.54	35.3	17459	3.56	56.6	318	4.27	26.8	102	3.84	36.2	7093
1985	3.68	37.7	17725	3.07	63.4	323	4.26	34.3	88	3.99	35.1	8457
1986	3.60	39.0	17299	2.92	54.3	328	4.38	29.9	97	4.37	33.8	7163
1987	3.40	39.6	18333	2.20	57.4	349	3.60	31.3	99	2.80	32.7	7951
1988	3.30	43.4	18581	2.40	69.8	336	3.90	31.2	104	4.30	29.8	7723

	Cotton Textiles (23)			Wool, Silk, Synthetic fiber textiles (24)			Jute, hemp & mesta textiles (25)			Textile products (26)		
	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)
1973	5.96	14.2	5719	4.58	12.3	2413	4.56	17.2	429	1.19	82.9	1642
1974	6.32	12.8	5560	5.54	11.4	2368	5.82	14.2	322	1.53	59.3	1652
1975	7.74	12.5	5968	5.43	12.1	2743	6.57	16.0	184	1.52	57.3	1979
1976	7.78	12.3	6213	6.14	10.4	3090	6.59	16.5	201	1.49	58.1	2192
1977	6.99	12.7	6508	5.80	11.1	3112	6.39	15.3	223	1.45	58.4	2347
1978	7.59	13.3	6701	5.56	12.0	3216	6.16	14.9	247	1.49	53.9	2577
1979	8.88	12.4	7207	5.72	13.2	3455	7.06	12.1	257	1.44	51.5	2907
1980	9.79	11.6	7189	6.71	12.7	3743	7.89	13.8	265	1.52	54.7	2889
1981	9.59	12.4	7141	6.95	13.9	4100	9.33	14.4	297	1.58	60.2	2943
1982	10.33	12.3	6569	7.83	12.9	3267	10.55	15.0	219	1.69	63.6	2491
1983	12.34	11.7	6731	9.27	13.6	3532	9.66	12.7	236	2.14	59.9	2621
1984	11.34	12.3	6760	9.31	14.9	2955	7.31	10.9	215	2.00	62.5	3063
1985	13.39	11.9	7073	7.97	19.1	3236	6.98	15.7	204	1.99	63.5	2835
1986	14.20	13.4	6981	8.84	19.9	2986	12.23	15.7	184	1.93	74.0	2821
1987	12.90	14.1	6844	9.00	19.4	3142	11.20	15.5	236	2.40	58.3	3141
1988	11.10	16.7	6801	9.30	19.6	3250	11.60	14.3	187	1.90	70.1	3159

(Contd.)

Table 2 : (contd.)

	Wood & Wood products furniture & fixtures (27)			Paper, paper product, printing (28)			Pulp, paper & boards (280)			Leather, & fur products (29)		
	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)
1973	3.07	36.8	2932	9.10	10.7	3779	15.75	7.7	560	0.92	91.5	594
1974	3.52	29.7	3158	9.56	9.6	3820	15.96	7.5	490	1.26	78.2	667
1975	3.85	28.6	3431	11.63	8.9	3936	20.06	6.8	424	1.23	71.0	670
1976	4.21	28.1	3573	11.40	9.1	4506	21.55	6.3	449	1.21	75.3	727
1977	4.01	28.0	3676	12.55	8.3	4439	23.58	5.8	538	1.35	68.7	762
1978	3.73	28.6	3788	11.76	9.1	4901	21.31	6.4	500	1.13	76.7	797
1979	3.96	28.0	3978	12.15	8.9	4743	21.42	6 3	587	1.17	65.1	862
1980	3.62	25.7	4033	12.89	8.7	4798	22.91	6.1	585	1.58	52.6	886
1981	4.34	25.9	4094	13.75	9.0	4890	24.13	6.1	672	1.69	58.0	899
1982	4.95	22.0	3618	14.20	8.8	4571	25.13	5.6	637	2.08	54.2	880
1983	4.99	25.3	3591	15.05	8.7	4710	25.75	5.4	734	2.46	49.8	942
1984	4.68	27.2	3847	15.25	8.7	4808	25.06	5.8	696	2.26	55.0	929
1985	5.20	23.3	3580	14.89	8.8	4870	24.68	5.6	802	2.42	53.1	999
1986	4.57	28.5	3873	15.46	8.7	4921	26.15	6.0	779	2.19	61.7	976
1987	4.30	31.1	3407	15.20	8.6	5096	26.10	5.8	899	1.90	71.9	1074
1988	3.80	36.1	3355	15.10	8.6	4960	25.30	6.4	808	1.90	65.9	1195

	Rubber & plastics (30)			Chemicals & Products (31)			Basic & Industrial gases (310)			Fertiliser & Pesticides (311)		
	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)
1973	3.67	31.1	1794	7.70	13.1	3043	18.18	8.2	389	13.75	9.2	335
1974	2.47	42.8	1952	8.07	10.8	3221	16.89	6.8	543	11.65	7.3	344
1975	2.05	50.0	2496	9.12	10.1	3732	19.70	6.1	639	13.43	6.4	378
1976	2.24	51.0	2831	10.17	10.0	4152	21.39	6.2	701	16.02	6.6	440
1977	2.25	52.5	2881	9.70	10.6	4674	20.63	6.9	764	17.05	6.6	469
1978	2.67	40.0	2350	10.26	10.9	4881	20.58	6.8	874	17.54	7.5	493
1979	2.68	38.4	3302	10.03	11.0	5328	19.95	6.1	883	16.09	8.9	503
1980	1.61	62.4	3498	10.66	10.0	5479	22.53	5.1	917	14.69	7.5	447
1981	1.75	57.3	3864	11.99	9.7	6834	20.94	5.7	1223	16.95	6.6	618
1982	2.05	51.6	3514	12.08	10.3	5350	24.61	5.7	934	16.88	7.3	442
1983	3.07	36.8	3778	13.84	10.4	5824	27.98	5.3	978	20.83	7.4	495
1984	2.24	52.8	3900	13.59	10.5	6032	26.29	5.8	1320	20.05	8.4	469
1985	2.22	59.3	3958	12.81	12.1	6402	26.88	6.1	1040	18.93	10.0	546
1986	2.68	52.3	4097	14.38	11.2	6335	27.84	6.4	1017	21.59	8.5	474
1987	3.90	35.9	4412	14.50	11.4	6518	28.60	6.6	1049	24.40	8.2	515
1988	3.30	42.2	4660	12.50	13.9	6946	26.50	7.8	1119	19.80	11.9	594

(Contd.)

Table 2 : (contd.)

	Paints & Varnish (312)			Drug & Medicines (313)			Non-metallic mineral products (32)			Structural clay products (320)		
	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)
1973	3.89	24.6	338	4.01	16.0	674	22.83	5.2	3757	27.69	5.8	1182
1974	4.84	17.2	372	4.49	17.0	682	24.44	4.7	3890	29.81	5.1	1223
1975	4.18	21.3	368	4.30	19.1	800	26.53	4.2	4820	31.45	4.8	1533
1976	4.87	19.2	403	5.33	15.3	865	26.69	4.4	5309	30.74	4.9	1641
1977	4.83	19.6	496	4.96	16.1	918	25.18	4.9	5558	30.35	5.2	1666
1978	5.18	19.5	498	5.11	16.7	958	26.03	4.6	5639	31.49	5.3	1727
1979	5.16	18.8	551	5.04	19.1	1070	25.82	4.5	6083	28.59	5.3	1899
1980	6.11	17.1	568	5.39	21.8	1121	25.99	4.7	6440	31.91	4.3	2159
1981	6.51	17.0	773	6.10	20.6	1434	27.88	4.6	7694	33.41	4.4	3048
1982	7.44	15.0	476	5.96	22.3	1131	28.54	4.6	6667	34.83	4.1	2495
1983	7.79	17.2	547	5.85	26.4	1187	30.39	4.4	7618	34.87	3.8	3117
1984	8.61	15.9	515	5.86	24.8	1265	30.78	4.3	7841	37.43	3.7	3146
1985	7.16	18.4	555	5.00	32.5	1358	31.54	4.7	8515	35.88	4.2	3421
1986	7.47	19.0	592	5.75	33.9	1374	33.94	4.6	8267	35.23	4.2	3247
1987	6.70	20.1	739	6.10	28.2	1497	34.50	4.7	8706	32.60	4.9	3445
1988	7.40	17.0	722	5.20	32.7	1554	34.60	4.9	9025	29.20	5.1	3486

	Glass & glass products (321)			Cement, Lime & plaster industry (324)			Basic metal & alloy industry (33)			Iron & Steel Industry (330)		
	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)
1973	24.98	5.4	391	32.14	3.1	126	12.04	8.7	4132	15.14	8.5	942
1974	29.13	3.7	932	33.72	2.4	126	13.74	8.1	4215	17.41	8.0	1114
1975	31.44	3.3	414	35.87	2.6	205	15.85	6.9	4562	18.69	7.3	1150
1976	31.89	3.8	448	36.60	2.7	226	16.19	7.0	4988	18.96	7.5	1143
1977	30.33	4.1	483	35.47	2.7	247	13.57	8.2	5054	14.11	10.1	1299
1978	29.90	3.7	560	37.04	2.4	232	17.06	6.4	5259	19.94	7.0	1332
1979	31.05	3.6	573	37.67	2.2	271	16.03	6.5	5538	17.67	7.0	1471
1980	30.02	3.8	590	37.25	2.4	261	15.91	7.1	5779	17.10	7.8	1546
1981	33.50	3.7	674	40.31	2.8	276	14.66	8.8	1714	14.66	8.8	1714
1982	34.27	3.9	607	37.61	3.1	276	14.41	7.9	5509	13.96	9.8	1474
1983	35.62	4.1	601	39.18	3.2	328	18.19	7.1	5888	18.90	8.7	1686
1984	34.67	4.3	567	38.16	3.7	366	17.16	7.3	5901	16.85	9.4	1657
1985	34.26	5.0	571	38.89	4.8	468	17.00	7.1	6077	16.87	9.0	1764
1986	33.50	4.6	556	43.37	3.8	448	16.03	8.1	6191	15.82	9.5	1822
1987	33.10	4.8	570	46.00	3.9	517	16.30	8.3	6184	16.00	9.9	1754
1988	33.60	5.0	596	45.50	4.2	558	14.90	9.0	6203	14.70	10.9	1829

(Contd.)

Table 2 : (contd.)

	Foundry for casting & forging (331)			Ferro alloys (332)			Copper manufacturing (333)			Aluminium manufacturing (335)		
	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)
1973	6.81	14.5	2440	31.63	4.3	49	4.55	14.0	92	18.23	8.1	161
1974	8.16	13.1	2519	28.86	4.7	21	7.18	8.6	74	19.29	8.2	141
1975	9.47	11.7	2737	38.40	3.6	42	9.91	6.0	111	24.66	4.5	200
1976	9.45	11.7	3094	31.72	4.5	70	13.05	8.1	116	26.80	4.5	183
1977	9.12	12.2	2973	32.16	4.1	43	10.89	7.3	117	27.72	4.2	232
1978	8.68	12.3	3121	34.44	4.2	49	11.26	7.6	96	29.22	4.2	253
1979	8.83	11.7	3173	37.05	3.3	49	10.45	8.3	119	31.05	3.8	280
1980	9.18	12.6	3293	40.37	3.5	53	12.65	6.9	141	30.03	3.4	308
1981	9.63	11.5	3307	36.49	3.6	60	12.30	8.9	164	33.14	3.2	317
1982	9.66	11.3	3126	40.59	3.1	35	17.24	6.9	149	33.78	3.7	318
1983	10.99	10.5	3208	42.78	3.3	65	14.65	8.2	143	35.66	3.8	364
1984	10.96	9.9	3313	39.13	3.3	53	16.44	6.9	129	35.85	3.7	335
1985	10.46	10.7	3337	42.06	3.7	54	11.85	10.1	144	38.42	3.5	331
1986	9.84	12.0	3365	41.45	4.3	64	15.99	6.8	167	36.59	4.2	328
1987	9.90	12.2	3313	41.80	4.4	80	10.10	10.2	175	34.40	4.6	335
1988	8.50	13.2	3236	42.90	3.9	76	8.30	10.0	193	31.00	5.4	395

	Zinc manufacturing (336)			Metal product & parts (34)			Machine tools & parts (35)			Agriculture machinery (350)		
	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)
1973	4.48	13.5	29	3.43	26.1	4434	3.49	31.3	4713	2.74	40.0	799
1974	7.83	14.4	11	3.74	24.4	4412	3.28	32.0	4808	2.89	35.6	707
1975	7.92	13.1	11	3.92	24.1	5260	3.66	28.5	5449	3.82	27.8	673
1976	7.56	13.6	12	4.19	23.3	5590	3.34	33.7	5881	3.07	37.1	621
1977	7.96	12.9	19	4.06	24.3	5657	3.52	32.1	6203	3.27	33.6	718
1978	13.30	11.5	20	4.01	23.8	5818	3.34	34.2	6387	3.12	35.6	703
1979	12.70	10.4	23	3.85	26.4	6230	3.19	34.2	6826	2.62	39.9	789
1980	13.54	10.4	24	4.27	23.9	6457	3.17	37.5	7011	2.84	41.1	786
1981	14.35	8.0	25	4.26	22.9	6563	3.21	52.9	7876	2.99	39.2	797
1982	16.40	8.3	21	4.31	22.3	5884	3.56	38.0	7207	2.92	42.2	717
1983	16.88	6.0	22	4.86	22.2	6054	3.93	38.6	7138	3.32	40.0	794
1984	18.00	6.0	21	5.26	18.0	6078	3.86	42.2	7168	3.29	41.3	734
1985	16.48	7.6	46	4.87	20.6	6307	4.16	42.2	7648	3.67	39.7	802
1986	19.94	7.4	33	5.03	28.5	5978	3.63	43.6	7254	3.25	48.0	700
1987	21.30	7.1	43	9.20	28.1	6390	3.40	54.2	7584	3.10	52.0	830
1988	19.70	6.0	45	5.20	26.8	6335	3.40	44.5	7711	2.70	52.3	775

(Contd.)

Table 2 : (contd.)

	Prime Movers, boilers (352)			Industrial machinery for food and textile (353)			Industrial machinery other than for food (354)			Refrigeration & AC (355)		
	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)
1973	2.75	50.4	623	3.65	31.2	1003	4.05	19.1	402	*	*	128
1974	3.17	49.6	689	3.65	29.1	977	3.91	20.8	541	1.57	51.0	161
1975	3.31	41.0	732	3.94	28.0	1028	3.08	25.7	437	2.71	31.1	121
1976	3.09	49.4	776	3.99	31.3	1130	2.99	26.2	499	1.70	35.2	130
1977	2.87	47.6	757	4.11	29.9	1250	3.71	19.7	642	1.79	39.3	151
1978	2.45	46.4	719	5.92	32.7	1289	3.65	21.8	656	1.82	38.8	155
1979	2.29	47.5	782	3.83	29.8	1375	3.45	19.9	740	2.93	32.4	162
1980	2.20	48.5	800	3.75	30.2	1359	3.20	26.9	737	1.79	41.9	200
1981	2.28	47.9	1097	3.86	30.5	1565	3.10	27.6	768	2.00	41.8	259
1982	2.77	41.5	822	4.26	30.1	1250	4.05	21.3	718	1.91	47.4	164
1983	3.42	36.1	838	4.46	31.0	1448	3.72	27.4	725	3.05	46.4	167
1984	2.98	44.2	942	4.93	29.7	1266	3.50	29.1	715	2.87	49.8	165
1985	3.10	46.6	940	*	*	1296	2.93	33.2	829	2.74	59.3	159
1986	2.55	55.2	871	3.91	44.9	1240	3.50	42.5	835	2.71	59.2	173
1987	2.40	59.9	956	4.10	44.2	1206	3.90	40.1	940	2.30	68.7	191
1988	2.80	48.6	902	3.70	48.8	1272	3.30	41.9	995	2.40	64.8	190

	Machine tools & parts (357)			Electrical machinery (36)			Electrical Industrial machinery (360)			Transport equipment (37)		
	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)
1973	5.25	20.0	590	2.01	41.3	2380	1.90	53.0	1141	3.78	26.2	1600
1974	4.84	25.0	586	2.33	34.9	2340	2.02	45.6	998	4.22	25.2	1680
1975	5.39	18.9	827	2.62	31.9	2390	1.94	46.7	843	4.39	25.0	2752
1976	5.34	18.6	847	2.47	36.3	2596	1.92	49.2	837	4.25	28.5	2204
1977	5.81	16.7	934	2.48	36.9	2740	2.03	47.8	915	4.62	26.5	2348
1978	5.38	17.9	910	2.44	39.1	2882	2.14	46.9	955	4.68	26.1	2528
1979	5.58	17.8	949	2.35	38.2	3277	2.06	46.6	1036	4.97	20.8	2867
1980	5.42	17.3	1009	2.35	45.5	3406	2.01	53.8	1046	4.33	24.6	2815
1981	5.23	21.2	1011	2.61	45.7	4229	1.99	59.3	1062	4.80	23.7	3339
1982	5.45	20.6	1166	2.91	46.3	3641	1.76	76.1	1138	4.86	25.2	2816
1983	5.61	22.9	1075	3.14	50.6	3661	2.46	67.3	1105	5.19	26.3	2815
1984	4.50	25.4	1027	4.00	42.1	3831	3.29	60.7	1148	4.95	28.1	3041
1985	5.40	24.8	1076	3.19	51.6	4066	2.49	70.0	1129	4.73	30.3	3267
1986	5.83	31.7	1032	2.97	58.6	3888	2.62	67.6	1071	4.89	30.9	3120
1987	5.60	33.0	975	3.10	58.1	4241	2.60	69.1	1304	4.60	32.0	3318
1988	5.40	29.4	1051	2.30	71.6	4496	2.20	79.0	1378	4.00	35.6	3345

(Contd.)

Table 2 : (contd.)

	Motor vehicles (374)			Motorcycle, scooter (375)			Bicycle, Parts (376)			Other Manufacturing Industry (38)		
	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)	Share of energy in total input %	Energy productivity ratio	Factories (Nos.)
1973	2.97	40.2	523	3.18	30.5	114	2.87	24.3	464	2.97	31.5	1662
1974	3.66	32.6	569	2.98	35.0	147	3.70	19.9	498	2.85	29.8	1566
1975	3.82	31.5	990	3.48	30.3	110	3.93	19.0	581	2.67	34.7	1473
1976	3.79	34.9	1021	3.22	36.2	146	4.18	19.0	600	2.91	32.9	1871
1977	4.32	31.5	1023	3.29	34.0	201	4.06	20.5	598	2.70	35.4	1897
1978	3.92	33.4	1113	3.88	31.1	215	3.85	20.2	643	2.49	37.7	1799
1979	3.68	32.0	1205	3.90	29.2	270	3.55	23.3	694	2.26	43.2	2047
1980	3.52	33.6	1297	3.82	34.1	235	3.18	30.3	676	2.33	46.1	1956
1981	4.14	30.5	1565	3.59	37.6	293	3.94	*	748	2.74	44.7	2383
1982	4.23	32.3	1334	3.73	38.0	255	4.51	26.0	638	2.75	51.5	1475
1983	4.78	32.7	1302	3.81	40.5	257	4.93	26.2	669	3.09	55.5	1871
1984	4.64	33.9	1529	3.70	39.2	287	4.44	27.5	658	3.15	60.3	1509
1985	4.30	36.8	1594	3.61	28.8	295	3.96	30.4	673	3.18	78.3	1725
1986	4.14	41.0	1567	3.41	41.4	348	4.24	31.7	627	3.53	65.1	1573
1987	4.00	41.5	1463	3.4	42.0	432	4.60	29.8	687	2.80	79.3	1742
1988	3.70	44.4	1498	3.3	46.8	460	4.10	32.0	691	3.20	71.6	1792

Notes:

* Cases with extreme values are not reported

Figures in brackets are the industry codes according to NIC

Compiled by:
K. Surya Narayanan
Asst. Director

Pollution from Viscose Staple Fibre Industries

NPC Pollution Control Division

The Viscose Staple Fibre units are typical sub-sectors of man-made Fibre Industry in India. There are four viscose staple fibre industries in India. The production of staple fibre stands at 0.5 million tonnes/annum against an installed capacity of 0.135 million tonnes/annum.

The Process

The viscose staple fibre production comprises three steps:

- Viscose Preparation/Formation
- Cellulose Re-generation
- After treatment and salt recovry.

Viscose Preparation/Formation

The commercial caustic soda is diluted to requisite strength and settled to remove impurities. The settled sludge bearing waste water is drained. The cellulose is first treated with 18% caustic soda solution to yield Alkali cellulose which is then dissolved batch wise in CS_2 in xanthator under vacuum to form cellulose Xantahte. Unreacted CS_2 is discharged into the atmosphere. The viscose solution is thereafter transferred to in succession to dissolver, disintegrator and blender for assuring uniform composition. After every batch of Xanthation and viscose transfer, the empty Xantahator is washed and washed water is either discharged or flushed to dissolver.

After the Xanthation process, the viscose solution is filtered in a three steps filter system. Periodic cleaning of filter presses and filter cloths generates waste water. The filtered viscose solution is finally deaerated using vacuum flash deaerator. The exhaust from the final stage containing residual CS_2 is discharged as process emission continuously.

Cellulose Re-generation

The Xantahte is drawn through spinnerettes continuously in a Spin Bath solution containing principally sulfuric acid. cellulose is regenerated as long strands, and CS_2 & H_2S are released. Though, the CS_2 & H_2S gases are continuously extracted from the entire machine are through appropriate suction hood and duct assembly and discharged into the atmosphere as process emission, still some gases are dispersed in shop floor causing fugitive emission. Although the maximum re-generation reaction is expected within the Spin Bath and machine area, certain percentage of re-generation continues to occur upto cutter stage due to entrapped CS_2 and ungenerated celulose. Immediately after cutter, entrapped CS_2 is recovered in CS_2 recovery system to the tune of about 40% of the CS_2 input in xantahtor. CS_2 is released by steam injection and recovered by 2-3 stage condensation system. Non condensables including minor quantity of CS_2 are discharged into the atmosphere. Due to frequent maintenance requirement of spinnerates and candle filters, continuous/intermittent flow of fresh water is maintained in the lower channel of spinning machine for hand washing and discharged as waste water. Further, viscose leakages from spinnerate gear pump, spillages from machine, periodic cleaning of entire machine during change over of product mix and floor washing activities generate waste water.

After Treatment & Salt Revovery

After CS_2 recovery the fibre in slurry form is subjected to hot water wash, caustic treatment for desulfurisation followed by washing, hypo treatment for bleaching followed by washing, soaping/finishing and finally drying and balling Desulfurisation and bleaching operations cause process emission. All treatment and washing operations generate waste water and called sump zone

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Energy Input Analysis of PVC Manufacturing

NPC Energy Management Division

The energy input analysis carried out for PVC is intended to calculate the total energy input for the life cycle of the product. The energy requirement for manufacture of a product consists of the direct energy inputs like fuels, electric energy etc. In addition, there will be indirect energy input i.e. inputs required in the manufacture of materials used during processing. The energy used in the manufacture of a product (fuels, electricity etc.) are secondary energy sources.

In this study, electrical and thermal energy are recorded separately as kWh and Mega Joules (MJ) respectively. The following factors are considered while summing different energy inputs.

1. Direct and indirect energy inputs, i.e. the inputs required for process and transport is summarized as the Process Energy Requirement (PER).
2. PER and the net heat value of the raw materials together add up as the Gross Energy Requirement (GER).
3. GER plus the energy needed for disposal and minus the energy revenues that are available due to incineration with heat recovery, materials recycling etc. This is termed as Net Energy Requirement (NER).

PVC is manufactured in two different routes, viz. Naphta route and Alcohol route. Energy input analysis is done separately in these cases.

PVC (Naphta route)

Naphta, one of the products of refining, is cracked to produce ethylene. Ethylene, chlorine and acetylene is used for the production of vinyl chloride which is polymerised to obtain PVC resin. The final product is obtained after extrusion. Various inputs and their energy contents are given in Table 1.

PER, GER and NER are calculated on the basis of table 1.

PER = (39768 + 684) MJ + (2335 28) kwh
= 40452 MJ + 2363 kwh

GER = PER + 86679 MJ + 2126 MJ
= 129257 MJ + 2363 kwh

Assuming 10% of PVC recycled,

NER = GER – 3181 MJ
= 126894 MJ + 2363 kwh

PVC (Alcohol Route)

Alcohol is produced by fermentation and distillation of molasses. Ethylene, obtained by dehydration of alcohol reacts with chlorine to produce ethylene dichlorine. EDC is cracked and polymerised to produce PVC resin which is extruded to produce the finished PVC product. Various inputs and their energy contents are given in Table 2.

PER, GER and NER calculations of energy requirement based on Table 2 are as below:

PER = (64186 + 24482) MJ + 3868 kwh
= 88668 MJ + 3868 mkh

GER = PER + (7000 + 934615) MJ
= 1030283 MJ + 3868 kwh

Total energy content of surplus bagasse and dry leaves is 910253 MJ. Energy proportioned to molasses is 195054 MJ. Assuming 10% of PVC recycled.

NER = GER – (195054 + 3181) MJ
= 832048 MJ + 3868 kwh

Compiled by
N. Sajith
Asst. Director

Table 1. Energy Input Analysis for PVC Product (Naptha Route)

		Material Flow	Process Energy		Transport Energy		Energy content
		Kg	Purch. Elect. kwh	Fuel MJ	Elect. kwh	Fuel MJ	MJ (Mega Joule)
1.	Production of crude oil						
2.	Crude oil	1882			28	57	86679
3.	Refining			6068			
4.	Naptha	1750				44	
5.	Cracking		148	3309			
6.	Ethylene	453					
7.	Manufacture of chlorine		925	1632			
8.	Chlorine	688					
9.	Manufacture of Acetylene		69	7486			
10.	Acetylene	44					2126
11.	Production of vinyl chloride		231	8659			
12.	Vinyl Chloride	1042					
13.	Polymerisation		462	12614			
14.	PVC Resin	1000				233	
15.	Extrusion		500				
16.	Finished product	1000				350	
	Total		2335	39768	28	684	

Assumptions

1. Energy for production of crude oil from oil wells is regarded as negligible. 2. Transportation of crude oil for a distance of 380 km by ship and 170 km by pipeline. 3. Transport of Naphta for a distance of 100 km. 4. Energy apportioned for manufacture of chlorine by mercury amalgam process. Transport energy is neglected. 5. Transport of PVC resin by road for an average distance of 200 km. 6. Transport of finished product to the end user for an average distance of 300 km.

Table 2. Energy Input Analysis for PVC Product (Alcohol Route)

		Material Flow	Process Energy		Transport Energy		Energy content
		Kg	Purch. Elect. kwh	Fuel MJ	Elect. kwh	Fuel MJ	MJ (Mega Joule)
1.	Production of crude oil						
2.	Crude oil	152				5	7000
3.	Refining			490			
4.	Naphta	143				11	
5.	Production of fertiliser		19	4474			
6.	Fertiliser	255				44	
7.	Production of sugarcane			23681			
8.	Sugarcane	202400				23600	934615
9.	Dry leaves	67467					706207
10.	Production of molasses						
11.	Raw sugar	22264					
12.	Molasses	6072				354	
13.	Surplus Wet Bagasse	25401					204046
14.	Fermentation and Distillation		164	4048			
15.	Alcohol	1.26				118	
16.	Production of chlorine	5 Kl	1747	3084			
17.	Chlorine						
18.	Dehydration, cracking and polymerisation	1300	1438	28409			
19.	PVC resin	1000					
20.	Extrusion		500				
21.	Finished product	1000				350	
	Total Energy		3868	64186		24482	

Assumptions

1. Transport of fertiliser for an average distance of 450 km by rail and 50 km by road. 2. Transport of sugarcane by raod for a distance of 100 km. 3. Energy requirements in sugar mill is met through bagasse. 4. Transport of molasses for an average distance of 50 km by road. 5. Fermentation and distillation in a distillery with energy recovery through bio-gas. 6. Transport of alcohol for a distance of 100 km by road. 7. Chlorine by mercury amalgam process. 8. Transport of finished product to the end user for an average distance of 300 km.

News & Notes

PRAGMATIC GLOBALISATION

"The only way to globalise our economy is to integrate it with the present global move towards market economy. Globalisation means the ability to produce and sell goods and services in global markets in competition with others. They will succeed who can produce and deliver goods and services of high quality, making best use of the latest technology, at competitive cost". Thus spake Hari Shankar Singhania, President of International Chamber of Commerce at the Annual General Meeting of ASSOCHAM.

Singhania highlights three elements; cost, quality and Technology. "Cost involves efficient use of raw materials and energy; high productivity of machines; competitive labour cost per unit of labour, not necessarily low wages. "Quality" means not only quality of product, but also of services: speed, reliability, and customer satisfaction. "Technology", entails right and optimal utilisation of inputs, product performance, speedy transmission of information and data, and almost instantaneous transfer of money. Above all, "innovation", how to do things better than competitors. These are the elements for success in a globalised market economy. Here the Consumer is the final arbiter. His interest reigns supreme. Giving new choices to him is a prime function of the market, according to the famous industrialist.

Globalisation has given a new direction to international trade. Based on the comparative advantage of various economies, a package of end-products and services, which are of high quality and relatively cheaper in cost, is produced. Electronic components manufactured in the United States are used for assembling printed circuit boards on East Asian and Central American NICs on account of the obvious labour cost advantage. Therefore, printed circuit boards are exported back to Silicon Valley for further processing and the final products are sold the world over. The manufacturers farm out production of components obtained from sub-assemblies operating at centres far away from one another. It is this kind of sophistication to which the Indian economy and entrepreneurs must move not only in relation to production in India but also production abroad, said Singhania.

It is often remarked that while we, in the developing countries, talk of globalisation and liberalisation, developed countries seem to be moving towards protectionism of different kinds. Deeper analysis shows that such developed countries as have acted against the principles of market economy and globalisation are in difficulties. They are stuck in the problems of balancing budgets, reduced economic activity and unemployment. The new Director General of GATT, Peter Sutherland has said, "Virtually all protection means higher prices. And someone has to pay; either the consumer, or, in the case of intermediate goods, another producer. The result is a drop in real income and an inability to buy other products and services....".

Empirical evidence brings out clearly that the cost of saving a job using tariffs, quotas, subsidies or other measures is normally far greater than the weightage attached to the job itself. These are costs that accrue year after year. The burden falls on the consumers of the developed economies that are protectionist. Additionally, jobs are affected in developing economies insofar as their exports are denied access, warned the President of a large business house.

In this context, "Swadeshi" acquires a new meaning and dimension. It means:

- empowering the people and economy;
- the national ability and national pride to operate as a global player, and being a winner in the international market;
- international recognition of the national brands;
- being counted economically and politically in world fora and listened to; and above all,

- capacity to provide a decent way of life to our people.

The economic reforms underway in India, should be viewed in the light of the objectives just indicated. They cannot be attained easily. It is true that regulations, however vexatious, have helped quite a few companies to improve the bottomline. Now that the rules of the game has been changed, the same successful companies will be hard put to stand on their own legs.

It is idle to ignore the fact that there will be a transitory period where adjustments to reality have to be made. These adjustments must be made by the managements of the companies as well as by government playing a deliberate role of "facilitator". We, in business, must, of course, become alive to the change in the environment and attempt to improve our methods of manufacturing and marketing, both at home and abroad. We must gear ourselves to move from an import substituting to an export promoting scenario. Government, too, must help Indian industry to go ahead to meet competition, added Singhania.

There is much to be done to improve "externals" to the enterprise. Industry heavily depends on infrastructure and major inputs which are in the hands of the Government. The cost on account of the inefficient working of coal mines, of electricity boards, or railways, or ports, or customs, or telecommunications or road network, is very high, and continues to rise and constitutes a serious drag on our competitiveness. While it is good that government has opened the hitherto restricted areas such as electricity generation, supply and distribution, ports, roads, telecommunications and the like, the Government should denationalise existing infrastructure, at least a part, if not the whole, which would go a long way in not only reducing costs speedily, but also in raising efficiency. Improving the productivity of the existing infrastructure will yield immediate results. There will be greater capital and cost effectiveness. Such privatisation will also enable government to reduce the public debt.

The reforms process which has unfortunately slowed down must be speeded up. State Governments and their bureaucracies have yet to imbibe the new spirit. We are already late; So many countries are ahead of us. We have to catch up a lot. Investors now have a wider choice where to go. We have to compete with others for attention cautioned Singhania.

Indian private industry has been restrained by various regulations in the past, and the result is that we are small compared to world standards and are technologically weak. We have now new opportunities as well as new challenges. We are willing to compete, but we have to be enabled to strengthen ourselves. There has to be a conscious policy on the part of Government to make it happen. If there is one lesson to be learnt from successful East Asian countries, it is that domestic companies must be given all encouragement. In the new environment, Government has to play a bigger role and make larger investments in the social infrastructure like education, public health and family planning. Only if the majority of our people are able to stand on their legs and discriminate between good and bad that the nation as a whole can become stronger and self-reliant. Self-reliance is the core and substance of globalisation unlike self-sufficiency which is anti-thetical to globalisation. There are many varied and new tasks that have to be performed by all the social partners: government, business and labour. There is a need to forge a solidarity pact between the Central and State Governments, business, labour unions, financial institutions, professional and academic organisations, concluded Singhania.

SUBCONTRACTING FOR TECHNOLOGICAL DEVELOPMENT

Multinational Enterprises' (MNEs) main consideration in managing their subcontracting relationship is not one of charity, but one of reducing cost/risk while maintaining future flexibility in the face of market/technological uncertainties, concludes Wong Poh Kam, the APO Oshikawa fellow for 1989 in his Report, "Technological Development Through Subcontracting Linkages."

MNEs will only devote resources to transfer technological know-how to their suppliers of the expected returns from such efforts outweigh the costs (which include resource cost as well as potential rent discrpation). Moreover, many of the items that MNEs choose to subcontract out are precisely those items that they do not have the most advanced expertise to make in-house ; by subcontracting they can achieve lower cost or gain access to expertise they lack. In this way, they specialize in product technology while tapping the specialist process know-how for various inputs to their products. Consequently, even if they had wanted to, they are not in a position to transfer much know-how with regards to the process technologies for making many of the items that they subcontract out. As for their product technology, the MNEs thus may not have the incentive or expertise to transfer specific technological process know-how to their suppliers, they have tremendous incentive in ensuring that the suppliers' outputs perform according to specifica-

tions. It is this rigorous emphasis on input quality assurance that enables most MNEs to play an effective role in facilitating learning by suppliers: says the report.

The case studies from Singapore suggest that technology development of local SMEs through sub contracting has been very extensive. In nearly all cases, the SMEs have achieved considerable technological progress through their subcontracting activities. The extensive technological progress of SMEs through sub-contracting with MNEs is achieved mainly through various indirect technology transfer programmes-learning facilitation, inducement and spillover. Direct technology transfer activities by MNEs appear to be of lesser importance. The extent of technology absorption through sub-contracting depends on both the potential scope for absorption created by the sub-contracting relationship as well as the internal absorption capacity of the SME.

The study has also found out that the key factors that influence the potential scope for technology absorption through subcontracting with MNEs appear to be the degree of MNE's long-term commitment to the sub-contracting relationship, the degree to which the sub-contracted items have standardised or specialised characteristics and the extent of in-house MNE expertise on the supplier technology. These are in turn influenced by the nature of the technology and the competitive structure of the supply industry.

The key factors that influence the internal absorption capacity of SMEs appear to be the business vision and technology strategy of the entrepreneurs and the managerial/technical/organisational capability of the firm.

The study has inferred that though the subcontracting system in Singapore today is not as advanced as that of Japan, it appears to be more extensive than that of Korea, where subcontracting is largely confined to large national firms, and of Malaysia, where the local supporting industry is still relatively underdeveloped to fully maximise the potential scope for subcontracting.

TQM-BENCHMARKING INTERFACE

The philosophy behind the concept of competitive benchmarking is straightforward and appealing; identify the performance of your key competition, and match (or better) it within your organisation. It is claimed that to be internationally competitive, every organisation needs to conditionally benchmark its activities against the best in the industry, say J. Vaughn Clair and Andrzej Tomasz Gorecki in their recent article in the Quality Magazine (Oct. 1993).

However, all the positive publicity notwithstanding, the use of benchmarks is not a straightforward issue. There are many instances where their use can be dangerous to the business, warn Clair & Gorecki.

A danger of benchmarking is that it can lead to the violation of some of the fundamental principles of Total Quality Management (TQM). Surprisingly, there seems to be a consensus in the media that benchmarking is an integral part of TQM when in reality it is not. W. Edwards Deming warns about the danger of using numerical quotas, and is strongly opposed to running an enterprise on the visible figures alone. He states that the most important facts about any organisation are either unknown or unknowable. Employee morale, the suitability of current research programmes, customer perception of the organisation, corporate culture—all these factors are crucial for any enterprise, and they can all be adversely affected by the pursuit of numerical quotas and measurable objectives. It is not unusual for numerical targets to be achieved at the expense of these other areas and at the expense of long term initiatives. Numerical targets also introduce psychological limits, discouraging efforts for even more superior results. Finally, such targets often demand extra effort from the employees, whilst in reality business systems improvement is the responsibility of the management opine the authors.

In his writings, Deming is also strongly against searching for examples. A drive to match someone else's performance may lead to the acceptance and copying of solutions which often may be unsuitable to the organisation's situation. If the copy is not as good as the original, one may achieve for less, at the same or even greater cost, copying can also restrict innovation, giving preference to somehow else's solutions. Thus unless an organisation has a constancy of purpose, a commitment to the continuous process improvement, a commitment to its staff, strong leadership, and an understanding of the dangers of numerical targets, the use of benchmarking is likely to encourage mediocrity and short-term thinking caution Clair and Gorecki.

This is why the authors believe that organisations, especially those which have not yet adopted the philosophy of TQM, should be wary of using competitive benchmarks, but benchmarking the authors feel, is a valuable qualitative tool. Used as a qualitative tool, benchmarks can give important warning signals, if the performance of the organisation is significantly different

from the best practices around the world. Used as an alarm bell, competitive benchmarks are excellent in eradicating old paradigms.

The authors while saying that qualitative benchmarks are a hazard, unless used by an organisation which is fully committed to the principles of TQM, also ask whether such an organisation needs competitive benchmarks. They reason that the concept of continuing improvement which is an important element of TQM, continuing improvement which is an important element of TQM, implies the existence of an ultimate benchmark: zero-cost and zero-time. Those involved in the process of continuing improvement need to develop a new paradigm, accepting that zero-cost and zero-time are actually achievable. This is the only way to ensure that the process of improvement will never stop.

In this context all competitive numerical benchmarks must be seen as a mere compromise, to be used only as auxiliary tools. Furthermore, the authors warn that, even in such a limited role, we need to be aware of their potential pitfalls:

- Being numerical in nature, benchmarks can lead an organisation to draw the wrong conclusions.
- The competitive benchmark figures may not represent the world's best practices.
- Competitive benchmarks may give an organisation a false sense of security.

With these qualifiers in mind, quantiative competitive benchmarks can assist a TQM organisation by better motivating its improvement teams. It is always encouraging to overtake another player in the game. However, the main target must always remain the same: zerocost and zero time. Whilst the competitive information can be instrumental in shifting old paradigms, its use as a numerical target, on its own, will not help an organisation. The introduction of the philosophy of Total Quality Management is the first step to take on the road to continuous improvement.

MANAGING NONPROFIT ORGANISATIONS

Non-profit organisations not only serve the public good but they also make up a surprisingly large part of the Indian economy. Yet despite their social and economic importance, these organisations are notorious for financial mismanagement. Many hospitals, colleges and institutions, also finding themselves on increasingly shaky fiscal ground, have been forced to close during the recent years.

Fiscal problems arise for many non-profits because executives rarely know the language of financial management, observe Regina E. Herzlinger, Professor of Business Administration at Harvard Business School and Denise Nitterhouse, Associate Professor at De Paul University, in their book, "Financial Accounting and Managerial control for Nonprofit Organisations". One reason for this is that nonprofit corporate cultures, by nature tend to emphasize interpersonal skills and social concerns over pecuniary interests. Because many nonprofit managers are not trained in financial management, they may give fiscal planning matters a backseat to the social missions of their organisation, infer the authors.

Another factor contributing to financial murkiness in many non-profits is the fact that these organisations lack the signals of success or failure provided by the market place that for-profit businesses rely on in managing their operations. Yet another complication, note the authors, is the fact that the accounting and management information systems required of non profit organisation are much more complex than those required of business organisations of comparable size. Special accounting techniques must be used to keep track of the monies in non-profits, which are segregated into numerous individual funds. In addition, the outputs of non-profits often cannot be measured financially and may be difficult to measure in quantifiable terms.

Four fundamental questions that can help non profit managers simulate the feedback mechanisms of the marketplace serve as a cornerstone. The first question asks whether the organisations activities are consistent with its ability to finance them. Is the organisation overcommitted? Is an inordinate amount of money being spent on activities that benefit a relative few? Are sources of revenue in alignment with the organisation's principles, or will they ultimately corrupt the organisation's mission?

The second question addresses whether the non profit is maintaining intergenerational equity. Is the organisation, for example, robbing future generations to pay for present users? The third basic question, emphasise the authors, is whether there is an appropriate match between the sources and uses of revenue. Are long-term investments in fixed assets or tenured faculty, or merely with short-term sources that may dry up quickly.

The fourth fundamental question is "Are revenue sources diversified enough? Will the loss of any one of them be catastrophic for the organisation?" contend the authors. They demonstrate how to answer these questions with financial analyses and how to use the answers

to formulate financial management and management control strategies.

Nonprofit organisations educate us, nourish our souls with music and art, feed our poor, and protect the helpless among us. They are caretakers of the national conscience, pushing and prodding our system of government to uphold the tenets of democracy. They uphold the highest values of civilization-knowledge, beauty, charity and freedom: propound Herzlinger and Nitherhouse.

THE WORKFORCE OF THE FUTURE

There is a growing awareness that the 'quality an flexibility' of national training arrangements need to be improved in order to prepare and sustain the workforce of the future. The three components of competency – knowledge, skills and attitudes – will still be important but the priorities between them are likely to change, and the overall 'envelope' will expand. The current overemphasis on formal knowledge, role learning and examination will need to be replaced by content and methods that support lifelong vocational training at all levels and that also develop essential personal attributes, individual aptitudes; and latent abilities. this will include careful selection, aptitude testing and other means of abilities. This will include careful selection, aptitude testing and other means of ensuring a smooth, effective transition into higher education or the labour market.

Basic education at the pre-employment stage will require new structures, curricula and methods of teaching and assessment. At the post-employment stage, basic education will be necessary to facilitate redeployment. Secondary education will also need to include vocational training as well as further academic study, emphasize relevance and develop appropriate personal characteristics. In the United States, major improvements in quality particularly basic skills development, school college work connections, skills assessment state planning and coordination and incentives and accountability are recommended in post secondary education programmes leading to degrees or certificates in less than two years.

Skills training, on or off-the-job, should cover both job-specific and general skills with emphasis on durability and transferability. The role of on-the-job training under the supervision of highly skilled and committed master craftsmen, is of recognized value but may need to be adapted to the emerging needs of the workplace. Managerial competencies will also need to be reappraised. Facilitating change, planning and coordination, ensuring the continual updating of the work-force, encouraging and fostering teamwork and the development and use of retrained workers, will become increasingly important geatures of successful management.

However, there are several factors which may constrain the development of appropriate competencies. These factors will vary significantly between countries and enterprises. The lack of basic eduction can have serious implications for enterprises with large workforces which face union pressure to redeploy existing staff; in contrast more recently established manufacturing units can overcome this problem by being highly selective in their intake. It is interesting to note also that aptitude and attitude testing, as well as basic knowledge and skills testing, is a key component of the recruitment and selection procedures of Japanese and Korean companies setting up manufacturing plants in Europe and the United States. At the other extreme, the recognized high standard of basic education in Russia, particularly in mathematics and science subjects, has not compensated for the poor quality of on the job training and outdated manufacturing methods in that country.

The most important and recurring factors which inhibit the development of a responsive workforce include:

1. Basic education: PW standards for both those currently at school and those currently in a workforce.
2. Further education and training systems: lack of relevance and responsiveness in existing systems; inertia of organization, content and method; few effective links with the world of work; and in sufficient development of appropriate personal characteristics.
3. Retraining: lack of basic skills upon which to build; lack of resources in declining industries; shortage of experienced artisans and experts to provide quality training.
4. Manpower needs forecasting; unreliable training needs forecasting may lead to serious mismatching between supply and demand.
5. Government policy and regulations: lack of firm, coherent, government policy and support of national training programmes; legislated lateral occupational demarcations may reduce workforce flexibility, as may vertical demarcations which reduces incentives and opportunities for promption and mobility.

Some past mistakes may be avoided. It is unlikely for example, that too much credence will be given to long-

term manpower needs forecasting, because these have proved to be inadequate in periods of rapid change. Lessons have also been learned about excessive centralization and the need to develop decision-making. Unfortunately, other important problems like those arising from existing structures and practices of general education and training are less tractable.

The future is likely to see the development of a variety of labour market signalling techniques predicting short-term manpower needs. Labour market signals may be obtained from employment services data, 'key informant' surveys, tracer studies of trainees from particular training institutions and analysis of job advertisements in newspapers. Signalling techniques will probably have to be developed and adapted to meet local and sector requirements. The results must, however, be treated with a certain scepticism and used only as one component in an overall long-term strategy.

Certain constraints apply specifically to the further training of the existing workforce. They affect both upgrading (Providing an incremental increase in competency to match a new machine or technique) and retraining (developing a series of new competencies). Where the opportunities exist to pursue progressive staff upgrading and retaining, there may be other constraints. These include the resistance, uncertainty and lack of adaptability of the staff concerned, the lack of resources to provide suitable training, the lack of permission to leave work and attend training courses; and no guarantee that the competencies acquired will eventually be utilized. However, the need for continuing education and training is being recognized.

Source: *International Labour Organisation, Consequences of Structural Adjustment for Employment, Training, further Training and Retraining in the Metal Trades, Report II, 1994.* □

Defect Detection and Prevention

Quality assurance means absolute dedication to defect detection and prevention – at the source of defects.

To achieve this requires planning and standardization in all aspects of production, from production technology and work methods to inspection procedures and measurement control. Even more important is every employee's commitment to follow established standards and procedures and to take immediate action whenever problems occur. Comprehensive inspection helps promote adherence. Improvement activities integrated into daily work, such as TSS and the process capability drive, help establish patterns for successful problem solving. Finally, to thoroughly prevent quality defects at their source, the company's quality assurance effort must be extended to suppliers as well.

Reliability in quality must be balanced with reasonable costs. Cost assurance – through cost-control and cost-reduction activities in design and production departments – is the third and final focus of waste elimination activity in the Canon Production System.

Source: Canon Production System. Productivity Press, Madras, 1993.

Book Review

Macro Economic Theory: by M.C. Vaish, 9th edition, Wiley Eastern Limited, New Delhi, 1993. 652p. Rs. 95.

Macro economic theory is a substantially developed area in economic science. Hence it is considerably difficult to cover all the aspects in a single compact book. In the light of the complexities of the work involved, Prof. Vaish has done a remarkable job in compiling all the major materials on the subject in a lucid style without diluting the main theme of the book. This substantially revised 9th edition covers a syllabi prescribed for most of the Indian University Degree courses in Economics. Therefore, it can be treated as a concise handbook on Macro economic theory which students would find extremely useful. It is intended to help the students gain an introduction into the vast span of available literature and understand the intricate theories presented in basic reference books on macro economics with a proper base.

There are altogether fifty chapters on various macro economic theoretical issues in this volume which are classified into five parts. This classification helps both the beginners and others to understand the philosophy of macro economic theory in a systematic way. Initially the author deals with the evolution of macro economics as a separate branch in economic science. This section introduces the evolution and types of macroeconomics and presents the basic concepts as a prelude to the following accounting and theoretical sections for a better understanding. The second part of the volume deals with macro economic accounting techniques. Here most of the conventional accounting methods and problems usually confronted while including items on various heads are discussed at length. Part three exposes the macroeconomic theory on output, employment and money from both classical and Keynesian streams of thought. Most of the debates in the area of monetary theory and inflation are also discussed at length. Here we get an exhaustive account of the historical development of classical school of thought and Keynesian attack on it and the efforts of Pigou and Milton Friedman to uphold the classical bastion intact.

In part four, the author explains the relationships between macro economic policy and monetary and fiscal policies. This part also introduces the evolution of Banking system in India with necessary details. This section illustrates the credit creation process by commercial banks and the methods adopted by the Central Bank to control it with a detailed account of the functions of Central Bank in India. As a whole this section gives a fairly good picture of the monetary system and Banking policies. The section is supplemented with a historical analysis of the monetary policies of the Reserve Bank of India till the Sixth Five Year Plan. In part five, theories of trade cycles and economic growth are introduced. Here most of the trade cycle theories are discussed though with certain obvious omissions. For broadening the coverage, the author has tried to incorporate the theories on economic growth towards the end of the book.

The usual criticisms which are applicable to books of this kind are equally applicable here also. Hence, it may be noted that the book under review is not a substitute for the basic reference books on macro economic theory. It can serve only as an introductory book in this field. Printers devil also creates havoc with certain words and confuses the reader (pages 67, 186 etc.). However, with all its limitations this book can still be considered as an excellent introductory for the students on macro economic theory.

K.P. Sunny
Assistant Director (Research)
National Productivity Council
New Delhi - 110003

Emerging Issues in Human Resource Management: by Pramod Verma, Oxford & IBH, New Delhi 1992, 332p, Rs. 250.

The book, is a compilation with the latest state-of-the art in Human Resource Management by a group of human resource specialists (Jerome Joseph, Arun Monappa, Mirza S. Saiyadain, N.R. Seth and Pramod Verma). It is

addressed to managers and trade union leaders, and students of Personnel Management and Industrial Relations in academic professional institutions. The book, Unique in itself, however, will also be useful to the researchers, consultants, and trainers in the field of Human Resource Management. All the contributors to this volume belong to the Personnel Management and Industrial Relations Area at the Indian Institute of Management Ahmedabad, and the book reflects that strongly in the form of cases, surveys, conceptual papers, unlike a traditional Human Resource Management book. The references and bibliographies given are useful in view of the fact that Human Resource Management has today assumed a pivotal position and strategic importance in successfully steering organisations on the path of growth and excellence. Focussed on the organisational needs for better Human Resource Management, Verma elaborates on critical issues such as planning, acquisition, development of human resources and evolving a strategy for handling conflicts. The thought processes in the entire book are in the form of case studies and experience based, where the processes and issues are systematically brought out for understanding and developing new and emerging trends and concepts surrounding Human Resource Management.

Chapter presentation is logical. Seth in chapter I introduces the readers to some thoughts on Human Resource Management (HRM), resolving the paradox of modern HRM, by examining the industrial relations system in terms of the reality of conflict and cooperation contained within it. He advocates the spread of participative, and a humanistic culture to prevent the enterprise getting dragged into labour management discord and conflict under the influence of economic and environmental forces. What is important is, to deal with concrete human problems and needs, and not use knowledge as a waste or as a symbol of status or fashion to gain recognition in the professional club, states the author, as the latter is likely to be counterproductive. The status report of personnel functions in India is informative and deals with emerging personnel trends – HRD approach, social responsibility, workers participation assessment centre. Verma deals elaborately with new IR trends, again reiterating the issue of tackling problems imaginatively, thus creating a more 'humane' and 'positive work culture' in the organization. The book advocates the approach of facing challenges by integrated, 'Human Resource Planning functions with Organizational Planning activities' with proper forecast of human resource requirements, developing employee development, career planning, and HR information support system.

Chapter 3 on Manpower Planning in India, highlights the complexities of forecasting manpower requirements under varying conditions. Mirza S. Saiyadain presents almost a monograph on 'Employee selection,' with total stress on recruitment, screening and selection, in much detail and in a step by step fashion. Nothing better on selection at one place is possible – concepts, theories and practical cases, all class in itself, full of indepth qualitative and quantitative analysis. Saiyadain calls selection a science, requiring competence and academic preparedness to carry out responsibilities, and needing knowledge of psychology, psychometry, testing, interview and also a strong need to train those involved in selection to avoid even slightest errors of judgement. The issues of selection policy and procedures, marketing of vacancies, choice of recruitment advertising, campus recruitment, employment exchange and reservations are all important. There cannot be another exhaustive practical selection case (revised) than that of Ahmedabad Public Utility; and selection of Executive Trainers in Godrej presented in the book.

Arun Monappa gives the development oriented approach of Human Resource Management (a conceptual design) and its changing concepts (based on Canara Bank's experiences and approaches). Monappa opines that HRD activity is a continuing process and needs sustained support from all levels of the organization particularly the top management support, and also down the entire line to ensure HR activities do not degenerate into a routine exercise done for the sake of completing procedural requirements. The sense of conviction and dedication of line managers to subordinate development has to be high. Monappa stresses the need for using the specific systems and mechanisms purposefully and meshing of the organisational processes and attitudes with the total philosophy and approach to the demands of the total HRD system. The Canara Bank case on changing concepts of Human Resource Management focuses on a variety of interventions and innovative strategies adopted by the bank to motivate and involve the work-force in the working of the bank, to instil a new culture. The success of Canbank's HRD commitment, HRD systems and Processes have been magnificently proved as they have implemented effective communication and a sense of belongingness sense, not per se, but by actual understanding of the spirit of the system. It has succeeded in totally discarding the 'babu' dominated work culture and customer unfriendly image, which typifies the public sector banks of contemporary vintage.

Jerome Joseph gives the future directions of IR at workplace and Human Resource Regeneration (the JMEL

Experience). In the concluding chapters Seth presents some observations and reflections about the industrial man of India and a case for matching strategy with objectives for better management of industrial relations.

Verma's Compilation of emerging issues in human resource management in this age of changing economic and business scenario is timely, and will provide direction to several organisations striving to improve and turnaround their human resources planning management and development systems in an integrated manner. The book will provide a true direction, though additional reading will be required for a total dent in the organisation. The organisation of the book is well structured. Though it is written by different authors, the common thread of a practical approach runs through the entire length of the book. The book is educative, directive and practical oriented presenting a wide Compass of thoughts, ideas, approaches, processes, systems, procedures and policies related to an integrated Human Resource System. Credit goes to the joint conceptual depth and understanding of the authors with their varied backgrounds and rich experiences in managing, consulting, and teaching in the field of human resource management for contributing a volume which will definitely prove to ba a good shelf and reference book to the addressed targets.

V.N. Srivastava
Deputy Director (HRD)
National Productivity Council
Lodi Road
New Delhi - 110003.

Asian Crucible – The Steel Industry in China and India: by Gilbert Etienne et al, published by Sage Publications, New Delhi, Feb. 1992. pp 303, Rs. 285.

Steel has long been regarded as a core industry in the developing and developed countries for justified reasons and has come to be accepted as an important indicator of a country's state of economic development. India and China began to develop their respective steel industries almost at the same time, some forty years back. In 1952 China's output of crude steel was 1.35 mt and India's 1.47 mt (1950-51). Of late, China's growth of steel production has been moving at a much faster race. It was ranked World's 4th largest producer of steel in 1990 whereas India had by then had just moved to the 14th position. Out of the total world output of 189.8 mt in 1990-91, China had achieved a production of 66 mt as against 14.9 mt produced by India. The two being major countries, both by size and population within the developed world, it is only appropriate to make a comparison of their steel industries.

The book makes a detailed and balanced comparison between the two steel industries after tracing its path of development in both the countries. Taking into consideration various socio-economic, political and technological factors, the authors have tried to highlight the similarities and disparities between the two steel industries.

The book which was first published in Geneva in 1990 has been revised and republished in India on behalf of Modern Asian Research Centre in 1992. The problem with all such studies, however, is that by the time the study is published much of the supportive data in the study goes out of date. The basic data used by the authors for comparison purpose pertains mostly to the late eighties and therefore totally misses out in some respects, the latest position obtaining in the two countries.

The book starts with a brief account of the historical, political and economic backgrounds of the two countries, and also traces the development of the steel industry in the two countries, highlighting, in the process, major differences in the evolution and growth of the respective steel industries over the years. Since both in China and India after 1950 the development of steel industry was largely in the public sector, it is worth noting that the public sector plants have failed to achieve their assigned goals in both countries, though for somewhat different reasons.

The authors examine in detail the structure, organisation, location, capacity and output of the steel industry in both countries. The composition of Chinese steel industry differs in some aspects from that of the Indian industry and these are adequately brought out. While the steel plants are largely concentrated around iron and coal mines in China, their actual location based more on political considerations and in conformity with the conditions prevailing in the war stricken country, citing available data the authors rightly conclude that the progress in the development and modernization of steel industry during the eighties has been much faster in China than in India. As against 0.3 mt per year in India, the growth of steel production in China has been almost ten times at 3.0 mt per year. Comparing the technological efficiency and productivity the authors find that the Chinese plants are far ahead of Indian (TISCO) plants at 48 t/man year (it is much lower in SAIL) which is almost half of what the Chinese steel plants are obtaining at 90 to 98 t/per man year. There are a variety of reasons for this poor state of productivity in India and the authors have given a brief account of these in their book.

The authors present synoptic details of some selected steel plants, their capacity, equipment and facilities, their production and modernization, with a brief mention of the state of R&D etc. both in India and China. They also describe some of the current problems and how the two countries are trying to cope with these. The technological challenges facing the steel plants are also examined with particular reference to their efforts to replace obsolete plants, equipment and technologies considered essential for improving productivity. Incidentally, during the process of comparative evaluation of two steel industries and unintended comparison between the operational efficiencies of the private sector steel plants (TISCO) and the public sector plants set up in India in the later years, also comes into focus. This is as well because some of the weaknesses and shortcomings of the public sector also get highlighted. However, unlike the integrated steel plants, no direct comparison has been attempted between the mini steel sectors of the two countries which could have been an equally useful exercise in consideration of the fact that India has since decided not to set up any more integrated steel plants in the public sector.

Continuing the comparison of the two steel industries, the authors examine the availability, quality, reserves and rates of consumption of various input materials such as coal, iron ore, power and refractories etc. This is followed by an evaluation of various technological routes adopted in the two countries and how these have evolved over the years indicating the degree of efficiency with which these are being put to use. Giving details of manpower development in steel plants of the two countries, the author also makes a comparative evaluation of the state of human productivity in the two steel industries.

The author briefly examines the consumption pattern of finished steel in the two countries and the extent to which the shortfall has to be made up by imports. Chinese per capita consumption of steel being much higher than that of India, their imports of steel are also much higher by almost six times. To bridge the gap, both countries have gone in for modernization plans which are also referred to in the book. However, these details may not be of much use now as they may have already gone out of date particularly in the case of India. While there is a keen awareness of the fact that the quality of steel produced in the two countries is not of international standards, there is no specific mention in the book of how the two countries intend to tackle this important aspect of steel production. The question of prices is also briefly discussed but the fact that India has since gone in for full a decontrol does not find a mention in the book.

The remaining part of the book contains only a general discussion of Chinese and Indian steel industries. With an examination of the two steel industries in the global context, the authors discuss the future growth of steel industry in the two countries with reference to some special factors, both local and global.

The book contains a lot of comparative data but as the authors themselves point out the figures in respect of Chinese industry are not totally reliable because of the difficulties involved in obtaining correct information for the earlier periods. To that extent the reader will be at a disadvantage when drawing his inferences.

We have not seen the Geneval edition of the book, but the get-up of the Indian edition, except for the cover, does not seem to be very attractive and so is also its price at Rs. 256.

K.D. Kohli
Management Consultant
C 1/1246, Vasantkunj
New Delhi 110070.

Agricultural Development Price Policy and Marketed Surplus in India: Study of Green Revolution Region: by Ramesh Chand, , Concept, New Delhi, 1991, pp. 128, Rs. 100.

The book is the revised version of a doctoral thesis and contains the results of a series of exercises undertaken by the author in order "to develop the systems of output supply and factor demand equations for major crops of Punjab state by using the Normalised Quadratic profit function". Added to this the author has attempted to estimate the marketed surplus of major crops and tried to analyse the impact of factor and product prices on marketed surplus response. The third objective of the study is to suggest necessary price structure and productivity changes which will help to attain targeted levels of production and marketed surplus.

This slim book contains seven chapters with appendices. Even though the study area is restricted to Punjab state, the analysis of major crops undertaken by the author is quite relevant to farmers in other parts of the country in view of the nature of similarity of problems faced by them. Chapters 1 and 2 are basically descriptive and attempt to focus on describing the objectives of the study and the approaches adopted by similar studies. However, the author tries to establish that the extent of reliability of estimates of output supply and factor demand depends on the choice of analytical tools employed and hence he justifies opting for an approach of simultaneous

estimation of output supply and factor demand both on theoretical and empirical grounds as he feels that, "under this approach the studies using flexible forms of profit function model gave better and expected estimates than those based on Cobb Douglas form". The author claims that by adopting this approach, he will be making an important contribution in the field of agricultural economics for policy analysis. After going through the study, the reviewer finds it difficult to acknowledge this claim. Even though there is some merit in what the author says, the analysis of the response to price changes of output supply and factor demand cannot be undertaken for each crop separately as an isolated phenomenon (without reference to the impact of relative prices). The response to price changes to output supply and factor demand also needs to be looked at as an interlinked phenomenon (in relative terms) across crops. This does not seem to have come out clearly in the study. However, the author has succeeded in providing a methodological framework for analysing this intricate phenomenon of the response of output supply and factor demand to price changes. On this count, this book is a good addition to the literature on analytical agricultural economics and will be useful for researchers and administrators dealing with policies concerning agricultural prices and productivity.

H.G. Hanumappa
Professor and Head, ADRT Unit
Institute for Social and Economic Change
Nagarabhavi P.O.
Bangalore 560 072

Power, Poverty and Poison – Disaster and Response in an Indian City: by James Manor, Sage Publications India Pvt. Ltd., New Delhi, 1993, pp. 197, Rs. 220.

Incidences of liquor poisoning have been occurring in India with depressing and increasing regularity. The disaster that took place in the northern part of Bangalore in July 1981 was the worst liquor poisoning ever to occur in India. More than 300 people died after consuming poisonous illicit liquor. Hundreds of others who survived suffered varying degrees of disability.

The present book with a somewhat deceptive title analyses three general issues relating to the Bangalore disaster: First, how did it occur? Second, how to explain the varied responses of different institutions and groups in the urban 'system' to such a disaster? Finally, what is the nature of the encounters of the urban poor with these institutions and groups? The book is unique in the sense that it is perhaps the first to make a systematic analysis of the issue of liquor poisoning.

The book is divided into two parts and contains eleven chapters and an introduction. The first part containing four chapters describes what happened and explains why the poorer residents of Bangalore are compelled to drink what is commonly known as 'hooch'. It also examines how the liquor became poisonous in July 1981 by analysing the relationship between the producers of hooch and the state Excise Department which is the main agency responsible for enforcing the laws dealing with alcoholic drinks. The second part containing seven chapters evaluates the performance or non-performance of various institutions and groups – medical services, the press, the police, the courts and legal process, and the politicians regarding this issue.

The book narrates the beginning of the incident that took place between July 6-12, 1981. The agencies of the Bangalore cantonment and of the government of the state of Karnataka figure prominently in the narrative. The author tries to explain why the poor people expose themselves to the terrible risk of death by consuming illicit hooch. He seeks to find out the underlying factors in the policies of the state government on taxation and expenditure. The activities of the state Excise department and its relations with the producers of hooch, and the approach of the then Chief Minister of the state to that department have also been discussed.

The author has analysed the role that government hospitals, forensic laboratory, private hospitals and doctors played in the crisis and the responses of the press, the court and legal process, the police, and the politicians. The author observes that the responses of these institutions and groups to the tragedy varied greatly. A few senior government servants sought, with of course very little success, to trigger rapid action from state agencies, but many others were either unhelpful or downright obstructive. Much of the press compaigned rather briefly on behalf of the victims, but it was of little avail. The response of the police varied from indifferent to dismal during the crisis and thereafter many of them pocketed the money which the government intended to deliver to the survivors. The courts and the legal process failed on both the fronts of assisting the survivors and taking legal action against the hooch producers. The main exception was that the personnel in state-run hospitals struggled hard against great odds and saved many lives; but the private hospitals and practitioners remained woefully unhelpful. The author describes the plight of the survivors and indicates the implications of the tragedy suggesting some measures for avoiding such calamities in the future.

In recent years, the agitation by women protesting against the sale and auction of arrack has spread to

almost all districts of Andhra Pradesh. However, there has been a determined effort by the police, politicians and arrack contractors to dissipate the anti-arrack movement. The author could have included a chapter dealing with these issues in Karnataka. It would have exposed the negative response from the police, politicians and state to liquor tragedies.

The author has described only some well known facts which are common to all such incidents in a country like India. However, he deserves appreciation for his competent analysis of the tragedy and the associated phenomena. He also deserves thanks for writing a full fledged book on such an incident. However, the author could have chosen an appropriate title of the book. Instead of the present one, 'Liquor Tragedy in an Indian city – Disaster and Response' could have been the appropriate title of the book.

The book is written lucidly and the issues are analysed in such a way as to attract some general readers and the students of political science.

Madhusudan Ghosh
Senior Lecturer,
Deptt. of Economics & Politics
VISVA BHARATI
Santiniketan, Birbhum, 731 235.
□

A Better Place

In Japan, people often used to say that the shop floor, where the goods were made, was always more comfortable than the workers' homes.

– Akio Morita

We air-conditioned our factories before the offices.

– Akio Morita

Guidelines for Planning

1. The purpose of planning is to help us reach our targets.
2. Before developing a plan, identify the concrete steps to be taken and document the feasibility of every proposed improvement.
3. Before implementing an improvement, estimate and evaluate the expected results.
4. Keep everyone informed through visual control. This means every final plan must be formally announced and posted.

Source: Canon Production System. Productivity Press, 1993.

Select Bibliography on Manufacturing Management

AHMAD, B: Introduction to Flexible Manufacturing System. Paper presented in National Workshop on Advances in Manufacturing Technologies. Hyderabad, ASCI, 1990, p 28-30.

ANDERSON, JC and OTHERS, Operations-strategy – A literature review. Journal of Operations Management, 8(2), April 1989, p 133-58.

APO: Papers distributed to participants of Asian Productivity Organisation Training Course on Production Management. Japan Productivity Center, Tokyo, 1984.

BALAKRISHNAN V.: Production Automation and CIM. Paper presented in National Workshop on Advances in Manufacturing Technologies. Hyderabad, ASCI, June 1990, p 28-30.

BELCHER, JOHN G.: Gain sharing – The new path to profits and productivity. Houston, Gulf Publishing, 1991.

BERRY, LEONARD L and PARASURAMAN, A.: Marketing services Competing through quality. New York, Free Press, 1991.

BESSANT J. HAYWOOD W.: Experience with FMS in the UK. In C. voss. Ed. Managing Advanced Manufacturing Technology. Springer-Verlag, 1986.

BHOTE, KEKI R.: Design of Experiments Offers Powerful Tools for Quality Improvement. National Productivity Review, 11(2), Spring 1992, p 231-246.

BHOTE, KEKI R.: World class quality – Using design of experiments to make it happen. New York, American Management Association, 1991.

BIRD, ALLAN and DUNBAR, Roger getting the job done over there – Improving expatriate Productivity. National Productivity Review, 10(2), Spring 1991, p 145-156.

BLEST, JOHN P.: Action Teams in the Total Quality Process: Experience in Job Shop. National Productivity Review, 11(2), Spring 1992, p 195-202.

BLUMBERG, DONALD F.: Improving Productivity in service operations on International basis, National Productivity Review, 10(2), Spring 1991, p 167-179.

BOYNTON, ANDREW C. & OTHERS: Beyond Flexibility: Building and Managing the Dynamically stable Organization. California Management Reviews, 34(1), Fall 1991, p 53-66.

BRADFORD, JOHN W.: American Manufacturing in the twenty first century – World class or second class. National Productivity Review, 10(3), Summer 1991, p 403-408.

BROWN, JAMES H.: Erie Excellence Council Applies Deming's Principles. National Productivity Review, 11(2), Spring 1992, p 181-194.

BROWN, JOHN E.: Statistical Methods in Engineering and Manufacturing. Milkwaukee, Quality Press, 1990.

BUFFA, ES.: Meeting the competitive challenge. Homewood I11, Dow-Jones, Irwin, 1984.

BULLINGER, HJ and OTHERS.: Towards the factory of the future. International Journal of Production Research, 24(4), 1986, p 697-741.

BURNHAM, JOHN M.: Japanese Productivity: A Study Mission Report. American Production and Inventory Control. Society, 1983.

CALINGAERT, MICHAEL: Government – Business relations in the European Community. California Management Review, 35(2), Winter 1993, p 118-134.

CAMPBELL, JOHN P.: Productivity in organisations. San Francisco, Jossey Bass, 1988.

CARMAN, JAMES M.: Continuous quality improvement as a survival strategy – The southern Pacific Experiences. California Management Review, 35(3), Spring 1993, p 118-132.

CIAMPA, DAN: Manufacturing's new Mandate – The tools for leadership. New York, Wiley, 1988.

COCCARI, RONALD L.: How Quantitative business techniques are being used. Business Horizon, 32(4), Jul.-Aug. 1989, p 70-74.

COHEN SS.: Why manufacturing matters: The myth of post-industrial economy. California Management Review, Spring 1987, p 9-26.

COLE, ROBERT E.: U.S. Quality Improvement in the Auto Industry: Close but no cigar california Management Review 32(4), Summer 1990, p 71-85.

CHEN, FF.: Impact of flexible manufacturing systems on Productivity and Quality. IEEE Transactions on Engineering Management 38(1), 1991, p 33-45.

CHETTY, B.S.: A case study on Manufacturing Planning and Control Systems: Shriram Refrigeration Industries Ltd., Hyderabad ASCI (Mimeo) 1991.

CHETTY, B.S.: Impact of ASRS on Production Activity in Hindustan Cables Ltd., Hyderabad, ASCI, 1990.

CLIEAF, MARK S. VAN: In Search of Competence: Structured Behaviour Interviews. Business Horizons, 34(2), Mar-Apr. 1991, p 51-55.

CRAVENS, DAVID W.: Market-Driven Strategies for Competitive Advantage. Business Horizons, 34(1), Jan.-Feb. 1991, p 53-61.

CROSBY, P.: Quality is Free, New York, American Library, 1979.

DABBS, GORDON: Nonprofit Business in the 1990s: Models for Success. Business Horizons, 34(5), Sept.-Oct. 1991, p 68-71.

DAVIS, E.W., ed.: Project Management: Techniques, Applications and Managerial Issues. Norcross, Industrial Engineering and Management Press, 1983.

DEMING, W. EDWARDS: Out of the crisis. Cambridge, MIT, 1986.

DE MEYER, A and OTHERS: Flexibility – The Next Competitive battle – The Manufacturing futures survey. Strategic Management Journal, 10(1), 1989. p 135-144.

DERNEDDE, R: Manufacturing Automation – KSB Pumps Experiences in Germany and India. Paper presented in First Manufacturing Strategies Programme in ASCI. Hyderabad, Jan.16-18, 1992.

DERTOUZOS, ML and OTHERS. Made in America: Regaining the Productive Edge. MIT Commission on Industrial Productivity. Cambridge, MIT Press, 1989.

DICKIE, ROBERT B.: Western Business Should Approach Eastern Europe Mindful of Experience in East Asia. California Management Review, 33(4), Summer 1991, p 118-126.

DINGUS, VICTOR, R. and GELOMSKI, WILLIAM A.: A quality revolution in Manufacturing. Norcross, Industrial Engineering and Management Press, 1988.

DUNCAN L. and OTHERS: Boosting product quality for profit improvement, Manufacturing and Engineering 4(1), April 1994, p 106-108.

DUPUY, JOHN: Flexible Jobs – Key to manufacturing Productivity. Journal of Business Strategy, 11(3), May-June 1990, p 28-32.

EASTERN, GEORGE: The 1993 state of U.S. total quality Management – A Baldrige examiner's perspective. California Management Review, 35(3), Spring 1993, p 32-54.

EISENHARD, KATHLEAN M.: Speed and Strategic Choice: How Managers Accelerate Decision Making. California Management Review, 32(3), spring 1990, p 39-54.

GABOR, ANDREA: The man who invaited quality. New York, Times Books, 1990.

GALBRAITH, CRAIG S.: Transferring Core Manufacturing Technologies in High-Technology Firms, California Management Review, 32(4), Summer 1990, p 56-70.

GARVIN, DA: Operations Strategy: Text and Cases. New Jersey. Prentice Hall, 1992.

GARVIN, DAVID A: Operations strategy – Text and cases. Englewood, Prentice Hall, 1992.

GARVIN DAVID A: How the Baldridge Award really works. Harvard Business Review, Nov./Dec. 1990, p 80-95.

GELB, BETSY D and OTHERS: Competitive Intelligence: Insights from Executives. Business Horizons, 34(1), Jan.-Feb., 1991, p 43-47.

GERWON, DONALD: Manufacturing flexibility in the CAM era. Business Horizons, 32(1), Jan.-Feb. 1989, p 78-84.

GIFFI, CRAIG: Competing in world-class manufacturing – America's 21st Century challenge. Homewood, Busi ness One Irwin, 1990.

GLOBERSON, S. and OTHERS: Multi-Performance measures for better operational Centrol. International Journal of Production Research, 27(1), 1989, p. 187-194.

GOLD, B: Charting a course to superior technology evaluation. Sloan Management Review Fall, 1988, p 17-27.

GROVER, MP and OTHERS: Computer Aided Design and Manufacturing. New York, Prentice-Hall, 1984.

GUNN, TG: Manufacturing for Competitive Advantage: Becoming a world-class Manufacturer. Mass, Ballinger, 1987.

GUNDLING ERNEST: Ethics and Working with the Japanese: The Entrepreneur and the 'Elite Course' California Management Review, 33(3), Spring 1991, p 25-39.

HALL ROBERT W: Driving the Productivity Machine: Production Planning and Control in Japan, American Production and Inventory Control Society, 1981.

HAX: Building the firm of the Future. Sloan Management Review, April 1989, p 75-82.

HAMILTON, BRUCE E: Maintaining a tradition of quality and service by breaking traditions of large lot manufacturing. National Productivity Review, 9(1), Winter 1989/90, p 75-82.

HARMON, ROY L and PETERSON, LE IZOY, D: Reinventing the factory Productivity Break through in manufacturing today, New York, Free Press, 1990.

HAYES, RH and OTHERS: Link Manufacturing process and product life cycles. Harvard Business Review, Jan.-Feb., 1979, p 133-140.

HAYES, ROBERT H and OTHERS: Dynamic Manufacturing-creating the learning organisation. New York, Free Press, 1988.

HEATON, JAMES A.: Production by deduction. Beverge world, 108 (1445), July 1989, p 26-30.

HENKOFF, RONALD: Making your office more productive Fortune, Feb. 25, 1991, p 72-84.

HORTE, SA and OTHERS. Manufacturing strategies in sweder. International Journal of Production Research, 25 (11), 1987, p 1573-1586.

HILL, T: Manufacturing Strategy: Text and cases, Homewood I 11, Irwin, 1989.

HIRANO, HIROYUKI: JIT factor revolution – A pictorial guide to facotry design of the future. Cambridge, Productivity Press, 1989.

HUTCHINS, GREG. Partnering: A path to Total Quality in Purchasing. National Productivity Review, 11(2), Spring 1992, p 213-230.

IMBERMAN, WOODRUFF: Boosting plant performance with gainsharing. Business Horizon, 35(6), Nov.-Dec. 1992, p 77-79.

JAIKUMAR, R: Post-Industrial manufacturing. Harvard Business Review, Nov. - Dec. 1986, p 69-76.

JANSON ROBERT and OTHERS: The Team Approach to company-wide change. National productivity Review, 10(1), Winter 1990-91, p. 35-44.

JELINEK, M and OTHERS: The Interface Between strategy and manufacturing technology. Columbia Journal of World Business, April 1983, p. 26-36.

JONES, STEVEN D. and OTHERS: Comprehensive Measurement to Improve Assembly-Line work group Effectiveness. National Productivity Review 10(1), Winter 1990-91, p 45-56.

JURAN JM and OTHERS: Quality Planning and Analysis. New York, McGraw-Hill, 1980.

JURAN, JOSEPH M: Juran on planning for quality, New York, Free Press, 1988.

JURAN, M: Juran on leadership for quality, An executive hand book. New York, Freeman Press, 1989.

KANO, NORIAKI: A perspective on quality activities in American firms. California Management Review, 35(3), Spring 1993, p 12-31.

KAPLAM, RS: Must CIM be justified by faith alone. Harvard Business Review, Mar.-April 1986, p 87-95.

KAT O, HIROKI and KATO, JOAN S: Understanding and working with Japanese business world. Englewood, Prentice Hall 1992.

KAYDOS, WILL: Measuring Managing and Maximising Performance. Cambridge Productivity Press, 1991.

KENLAY, G. and HARRIS. KW: Manufacturing technology. London, Edward Arnold, 1979.

KESTER, W. CARL.: Global Players, Western Tactics, Japanese Outcomes: The New Japanese Market for corporate Control 33(2), Winter 1991, p 58-70.

KIM, C: Issues in Manufacturing Flexibility, International Journal of Integrated Manufacturing Systems, 2(2), 1991, p 4-13.

KLEIN, JANICE: The human coots of manufacturing reform, Harvard Business Review, 67, 1984,p 60-66.

KOTHA, S and OTHERS: Generic Manufacturing strategies: A conceptual synthesis Strategic management Journal, 10, 1989, p 211-13.

KORDUPLESKI, RAYMOND E and OTHERS: Why improving quality (or whatever happened to marketing Califonia Management Review, 35(3), Spring 1993, p 82-95.

KUSHAIK, A: Flexible manufacturing Systems: A structural approach. International Journal of Production Research, 23(6), 1985, p 1057-1073.

LANDEN DELMAR L.: Understanding-and-Improving-Organizations Through Cybernetics. National Productivity Review, 10(1), Winter 1990-91, p 5-18.

LEDDICK, SUSAN: Teaching Managers to Support Quality-Improvement Efforts. National Productivity Review, 10(1), Winter 1990-91, p 69-74.

LEIVA, WILLIAM A: Commonsense Product Development. Business Marketing, 74(8), Aug. 1989, p 44-48.

LEVINE, DAVID I: Participation Productivity, and the Firm's Environment. California Management Review, 32(4), Summer 1990, p 86-100.

LINCOLN, JAMES R.: Employee Work Attitudes and Management Practice in the U.S. and Japan: Evidence from a Large Comparative Survey, California Management Review. 32(1), FALL 1989, p 89-106.

LUDEMA, KENNETH C. and OTHERS: Manufacurting egineering Economics and processes. Englewood, Prentice Hall, 1987.

LUDEMAN, KATE: The work ethic—How to profit from changing values of the new work force. E.P. Dutton, 1989.

MALI, P: Improving Total Productivity, New York John Wiley & Sons, 1978.

MATHUR, HAL F. and OTHERS.: The Master Production Schedule, 2nd ed Atlanta George Plossl Educational Services, 1977.

MAGJUKA, RICHARD J.: Should Membership in Employee Involvement Programs be Voluntary & National Productivity Review, 11(2), Spring 1992, p 203-212.

MAJUMDAR, AMIT and OTHERS.: Planting the seeds of TQM. National Productivity Review, 10(4), Autumn 1991, p 491-498.

MANDEL, STEPHAN F.: A competitive challenge—How supermarkets can get into the productivity loop. International Trends in retailing, Spring 1991, p 39-49.

MARTENSSON, N: Applications of Industrial Rubots: Technical and Economical Constraints. NATO ASI on Rubotics and Artificial Intelligence, Italy. 1983.

MASKELL, BRIAN H.: Performance measurement for world class manufacturing—A mode for American companies. Combridge, Productivity Press, 1991.

MC ELROY, JOHN: Little big plants. Automotive Industries, 168(12), Dec. 1988, p 66.

MCMILLAN, JOHN. Managing Suppliers: Incentive Systems in Japanese and United States Industry. California Management Review, 32(4) Summer 1990, p 38-55.

MENG, G. JONATHAN,: Using Job Describptions, Performance and Pay Innovations to support Quality. A Paper Company's Experience. National Productivity Review, 11(2), Spring 1992, p 247-256.

MEREDITH, J: The strategic advantages of the factory of the future. California Management Review, Spring 1987, p 27-41.

MILLER, JG and OTHERS. Manufacturing strategies. Executive Summary of the 1988 Manufacturing Futures Survey (Manufacturing Roundtable Research Report) Boston University, 1988.

MITCHELL, DANLEL JB: Employee Benefits and the, New Economy: A proposal for Reform. California Management Review, 33(1), Fall 1990, p 113-130.

MIZUNO, SHIGERU: Company-wide total quality control Hong Kong, Nordica International, 1992.

MOIR, PETER W.: Profit by quality—The exentials of Industrial survival. New York, John Wiley, 1988.

NEMETH, LOSZLO: Efficiency Does Not Equal Productivity. Business Horizons, 34(2), Mar.-Apr. 1991, p 82-86.

NOLEN, J: Computer Automated Process Planning for World Class Manufacturing, New York, Marcel Dekker, 1989.

ODDOU, R. GARY and OTHERS.: Succession Planning for the 21st Century: How well Are we Grooming Out Future Business Leaders? 34(I), Jan.-Feb.-1991, p 26-34.

ONKVISIT, SAK AND SHOW, JOHN J.: Myopic Management: The Hollow Strength of American Competitiveness. Business Horizons, 34(1), Jan.-Feb. 1991, p 13-19.

ORLICKY, JOSEPH A.: Material Requirements Planning New York, Mcgraw Hill, 1991.

OSBRUG, BARRY. Finding and Using a Manager's Power to Improve Productivity. National Productivity Review, 10(I), Winter 1990-91, p 19-34.

PAVITT, KEITH,: What we know about the strategic Management of Technology. California Management Review, 32(3), Spring 1990, p 17-26.

POWAR, SHARAD: Need for Competition for cost-effectiveness. Address to the Managers of Hindustan Aeronautics, Oct. 1991, Bangalore.

PETTY, MM AND GRAY, LAWRENCE F.: From Maturity to growth in manufacturing—A success story in managing change. National Productivity Review, 9(2), Spring 1990, p 179-192.

PLOSSL, KEITH R.: Engineering for the control of Manufacturing. Englewood, Prentice Hall, 1987.

PLOSSL, GEORGE W.: Production and Inventory Control: Applications Atlants, George Plossl Educational Services, Inc. 1983.

PLOSSL, GEORGE W.: Production and Inventory Control: Principles and Techniques. Englewood Prentice-Hall, Inc, 1985.

PLOSSL, GEORGE W.: Production and Inventory Control: Principles and Techniques, Englewood, Prentice-Hall, 1985.

PLOSSL, GEORGE W.: Production and Inventory Control: Principles and Techniques, Englewood Prentice-Hall, Inc. 1985.

PLOSSL, GEORGE W.: Production and Inventory Control: Applications Atlanta, George Plossl Educational Services, Inc., 1983.

PRICE, MICHAEL AND CHON, E. Eva TQM in a small, high-technology Company. California Management Review, 35(3) Spring 1993, p 96-117.

PRITCHORD, ROBERT D. and OTHERS: Measuring organisational Productivity with Promes. National Productivity Review, 9(3), Summer 1990, p 257-272.

PRITCHARD, ROBERT D. and OTHERS: Implementing Feedback Systems to Enhance Productivity, National Productivity Review, 10(I) Winter 1990-91, p 57-68.

PORTIS, BERNAR and HILL NEIL: Making Employee Participation a Way of Life: Four Experiences. National Productivity Review, 10(4), Autumn 1991, p 481-490.

ROBSON, ROSS E.: The Quality and Productivity Equation—American Corporate Strategices for the 1990s. Cambridge, Productivity Press, 1990.

ROBSON, GEORGE D.: Continuous Process Improvement Simplifying Work flow systems, New York, Free Press, 1991.

ROSE, FRANK: New Quality Means service too Fortune, April 22, 1991, p 97-111.

RUBIN, PAUL H.: Managing Transactions to Enhance Corporate Performance. National Productivity Review, 10(4), Autumn 1991, p 519-532.

SAFIZADEH, M. HOSSEIN. The case of workgroups in Manufacturing Operations California Mangeement Review, 33(4), Summer 1991, p 61-62.

SOMIEE, SACED.: Productivity Planning and strategy in Retailing. California Management Review, 32(2), Winter 1990, p 54-76.

SCHROEDER, R.J. and OTHERS.: The content of Manufacturing Strategy. Journal of Operations Management, May, 1986 p 405-416.

SCHONBERGER, RJ: World class Manufacturing: The Lessons of Simplicity Applied. New York, The Free Press, 1986.

SCHONBERGER, RICHARD J: Japanese Manufacturing Techniques, New York, The Free Press, 1982.

SCHONBERGER, RICHARD J: Japanese Manufacturing Techniques, New York, The Free Press, 1982.

SCHMENNER,: The merit of making things fast. Sloon Management Review, Fall 1988 p 11-17.

SCHULTHEISS, EMILY E.: Optimizing the organization—How to link people and technology Cambridge, Ballinger, 1988.

SHANI, AB and OTHERS.: Myths and Misconceptions About the Dynamics of Innovation. National Productivity Review, 10(1), Wonter 1990-91 p 75-84.

SHINGO, SHIGEO.: Study of Toyota Production System, Tokyo Japan Management Association, 1981.

SHOICHI, S.: Keynote Address. Managements and Manufacturing Engineering. The International confernece on Industrial Automation (Auto Tech. 1987) Hong Kong Productivity Centre, Oct. 1987 p 15-16.

SMITH, ELIZABETH A.: The productivity manual-Methods and activities for involving employees in productivity improvement. Houstan, Gulf Publishing Co. 1990.

SREENIVASA, RAO C.: CNC Machine Tools and Their Applications: The Experiences of Praga Tools Ltd., Paper Presented in National Workshop on Advances in Manufacturing Technologies, Hyderabad June, 1990 p 28-30.

STUMER, W.: The Focused factory. Harvard Business Review, May-June 1974, p 113-121.

SUMANTH DJ: Productvity Engineering and Management. New York, McGraw-Hill, 1984.

SWAMIDASS, PM: Manufacturing Flexibility Operations Management Association Monograph, No. 2, 1988.

SWAMIDASS, PM: Questionnaire Developed for Measurement of Manufacturing Strategy Content Variables. University of Missouri, Columbia (Mimeo), 1990.

SWAMIDASS, PM AND NEWELL, WT: Manufacturing Strategy, environmental uncertainty and performance – A path analytic Model. Management Science, April 1987, p 509-524.

TALLEY, DORSEY J: Total Quality Management-Performance and cost measures. Milwaukee, ASQC Quality Press, 1991.

TOMPKINS, JAMES A.: Winning Mnaufacturing – The how to book of successful manufacturing. Norcross, Inst. of Industrial Engineering, 1989.

VALERY, N: Factory of Future. The Economist, May 30, 1988, p 1988.

VASINA, LEOPOLD S.: Total Quality Control: An overall Organizational improvement strategy. National Productivity, 9(1), Winter 1989-90, p 59-74.

VENKATARAMAN, V: Factory Automation: Features and Trends. Paper presented at National workshop on Advances in Manufacturing Technologies, 1990.

WAGHODEKAR, PH: A critique of some current group technology techniques. Industrial Engineering Journal 15(8), 1986, p 20-31.

WHEALRIGHT, SC: Reflecting corporate strategy in Manufacturing decisions. Business Horizons, Feb. 1978. p 57-66.

WHEELRGIHT SC: Manufacturing strategy: Defining the missing link. Strategic management Journal 5, 1984. p 77-91.

WHYTE, WILLIAM FOOTE: The new manufacturing organisation – Problem and opportunities for employee involvement and collective bargaining, National Productivity Review, 9(3), Sum 1990, p 337-348.

WOLFE, BONNIE HEINEMAN: Finding the International Niche: A "How to" for American Small Business. Business Horizons, 34(2), Mar.-April 1991 p 13-17.

WOOD, PATRICIA B.: How Quality government is being Achieved. National Productivity Review, 11(2), Spring 1992, p 257-264.

S.N. VIG
Deputy Director
NPC, New Delhi

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Government Policies & Productivity: The Asian Scene

A. Vaidyanathan & N.K. Nair

Productivity is normally understood as a micro level phenomenon; something to be achieved by the managers through their techno-managerial decisions. But can productivity techniques lead to higher performance under all macro policy environments? How can the government facilitate large scale improvements in productivity at micro level through the mechanism of an appropriate macro policy framework? The authors review the experiences from Asian region, particularly, from Japan, Republic of Korea, Republic of China, Singapore, Hongkong and India.

A. Vaidyanathan is Professor (Emeritus) at the Madras Institute of Development Studies, Adayar, Madras-600 020 and a former member of the Planning Commission, N.K. Nair is Director (Research) of the National Productivity Council, Lodi Road, New Delhi-110 003. *Excerpts from a paper presented at the Asian Productivity Organisation (Tokyo) Top Forum for Policy/Decision Makers on Role of Government Policies in Productivity Improvement in Asian Region, held in New Delhi (Nov. 2-5, 1993).*

Current Economic Trends & Concerns

Despite the prolonged global recession, the economies in the Asia-Pacific region continued to show robust growth in 1992 (table 1). The average annual GDP growth rate in 1992 for the region as a whole accelerated to 7 per cent from 6.1 percent in 1991; while the average inflation rate fell to 6.7 percent from 8.4 percent in 1991. The Asian Development Outlook Report (1993) of ADB anticipates the external environment for the Asian countries to improve somewhat as a recovery in the world economy is led by some revival in economic growth in North America. However, growing protectionist sentiments, as reflected in the prolonged GATT negotiations (Uruguay Round), remain a disturbing feature threatening free and growing foreign trade which has been an important factor contributing to post War economic boom.

A sharp acceleration in China's economy in recent years, a slow down in newly industrialising economies (NICs) and creditable progress in many others are the significant highlights of the Asian economic scene today. Labour markets remained tight in NICs and in most South East Asian countries. Skill augmentation schemes (including deskilling of obsolete occupations) may assume centre stage in the policy agenda of many Asian industrialised nations. In South Asia, serious infra-structure bottlenecks persist which in part are responsible for the slow growth of the economies of the region. The countries of South Asian region will have to augment infrastructure facilities (Power, Transport & Communication, Health) on a priority basis. Shortage of adequate financial resources in these economies is a serious handicap, constraining their efforts in this direction. An active policy of attracting foreign direct investments into these sectors is being pursued by many countries including those in South Asia, yet to receive any promising response from the prospective investors.

Table 1: The World Economy : Select Indicators (Annual changes in per cent)

	1991	1992	1993	1994
Real GNP World	0.1	0.5	1.5	3.5
Industrialised Countries	0.5	1.5	1.9	2.7
United States	–1.2	2.1	3.2	3.3
Japan	4.0	1.5	2.1	2.5
Germany	1.0	1.4	0.0	2.7
Developing Countries	3.4	5.1	5.5	5.8
Africa	1.5	2.0	3.0	3.2
Asia	6.1	7.0	7.2	7.4
Latin America	2.8	2.4	2.5	3.0
Middle East and Europe	0.0	6.1	7.0	7.2
Eastern Europe and former Soviet Union	–9.7	–16.0	–10.0	5.5
World Trade				
Volume	2.6	4.0	5.6	6.1
Non-oil primary commodity prices	–4.5	–0.1	1.5	3.0
Oil prices	–17.0	0.6	–1.7	0.6
Manufactured export prices	–0.5	4.6	3.5	4.0
Inflation	4.4	3.2	3.1	3.4

Note: figures for 1993 and 1994 are based on projected data
Source: Asian Development Outlook, 1993, Table 1.1

The balance of payments situation remained recognised manageable in most countries of the Asian region. Good harvests resulting from favourable weather improved the supply situation in most of the South Asian economies. Despite a slowdown in overall import growth, their combined position on the current account of balance of payments deteriorated in 1992. The current account deficit widened from $5.2 billion in the previous year to $8.9 billion in 1992. The current account surplus of NICs and China narrowed, while the current account deficit in South Asia widened and that in South East Asian countries improved to some extent. The currencies of Malaysia, Singapore and Taipei China appreciated against the US dollar, imparting deflationary pressures to their economies.

With the gradual recovery of the world economy and the favourable impact of policy reforms in many Asian countries during recent years, overall economic growth is expected to be maintained at over 7% during 1993 and 1994 (table 2). Inflation is expected to abate slightly, although it will remain an important concern in many countries. The balance of payments conditions are projected to deteriorate further as imports will grow more rapidly than exports because of further trade liberalisation and large investments in infrastructure.

Long Term Trends

Economic development, as a means to enable people to live in health and comfort, and afford them opportunities to explore and realise their potentials as human beings, is a major challenge and a central preoccupation of our times. This is of particular importance in Asia. Most countries in this continent, barring a few exceptions like Japan and Thailand, emerged from long colonial rule or control, only during the past 4-5 decades and became free to pursue an active policy for development to serve their interests rather than that of the colonial powers. Being late developers, Asian countries had the benefit of large accumulated scientific knowledge and technology. Rates of saving and capital accumulation have increased, in several cases, to 25 percent of the GDP or above. The overall growth rate during the last 3-4 decades in the continent as a whole is far higher than in the developed countries in a corresponding stage of development. Health status has improved largely as a result of the control of major communicable diseases, the extension of curative health facilities and increased food consumption. Educational facilities have spread and literacy rates have increased rapidly. There has been a remarkable transformation in both agriculture and industry, marked by faster diffusion of modern technology, a significant and sustained rise in crop yields and a rapid expansion of industries. Particularly remarkable is the pace with which some countries (the NICs) have not only mastered sophisticated and complex industrial technologies but demonstrated the capability to develop new products and techniques which can compete successfully with those of developed countries.

Despite all these, mass poverty and unemployment persist in Asia; its magnitude being distressingly large. More than 1 billion people — one fifth of the world population — live on less than $1 per capita per day: a level of income which the US and Europe attained nearly 200 years back (Summers & Thomas, 1993). The bulk of this billion poor of the world are in Asia (table.3).

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The striking feature of the Asian growth scene today is the wide variation among the nations in performance; during the 1970's the GDP growth rate ranged from less than 4 per cent per annum (India, Nepal) to over 9 percent

Table 2: Developing Asia: Selected Indicators

	1990	1991	1992	1993	1994
Gross Domestic Product			Annual percentage change		
Developing Asia	5.9	6.1	7.0	7.2	7.4
Newly Industria.Econ.	6.9	7.3	5.3	6.2	6.7
PRC and Mangolia	3.9	7.5	12.8	11.0	10.0
Southeast Asia	7.7	6.3	5.8	6.5	7.1
South Asia	5.2	2.1	4.7	5.3	6.0
Inflation			Percent change — CPI		
Developing Asia	7.1	8.4	6.7	6.9	6.4
Newly Industria.Econ.	7.0	7.6	5.9	5.4	4.9
PRC and Mangolia	1.3	5.1	6.4	9.0	8.5
Southeast Asia	7.3	8.8	5.3	5.6	6.4
South Asia	12.7	13.3	9.7	8.2	6.5
Resource Gap			Percent of GDP		
Developing Asia	0.3	0.0	–0.5	–1.5	–0.7
Newly Industria.Econ.	2.4	1.2	0.9	–1.6	0.5
PRC and Mangolia	3.5	3.2	0.9	0.5	–0.1
Southeast Asia	–2.2	–2.7	–1.5	–1.9	–1.6
South Asia	–4.1	–2.9	–3.6	–3.2	–2.9
Current Account			$ Billion		
Developing Asia	–6.2	–5.2	–8.9	–13.4	–19.2
New Industria.Econ.	10.8	6.8	5.8	6.0	5.6
PRC and Mangolia	11.4	13.7	10.4	5.7	–0.4
Southeast Asia	–14.9	17.4	14.2	14.6	14.3
South Asia	–13.3	–8.0	–10.7	–10.5	–10.0
Debt-Service Ratio			Percent of goods and services exports		
Developing Asia	16.0	13.9	14.1	13.1	11.3
Newly Industria.Econ.	10.7	7.1	10.9	10.3	6.8
PRC and Mangolia	11.6	12.0	11.0	10.5	10.0
Southeast Asia	18.5	15.5	15.0	13.3	11.0
South Asia	26.0	26.0	23.7	23.5	24.6

Source: Asian Development Outlook, 1993.

per annum (Korea, Taiwan, Hongkong). During the 1980's the range was even wider (–.1% in Burma to over 10 percent in China). Further, the differences in sectoral growth rates are relatively wider in agriculture than in industry (table 4.).

Differentials in GDP growth rates and in the rates of population growth (which vary from less than 1 percent to 3 percent a year), taken together with differences in the initial position (in terms of percapita incomes) account for the wide variation in per capita income among Asian countries. Per capita GDP, in 1991, ranged from less than $200 in Bhutan and Nepal to nearly $27000 in Japan. South Asia and China have per capita GDP below $500, while the NICs (S.Korea, Taiwan, Hongkong and Singapore) have more than $5000. In South East Asia, the countries of the Indo-China peninsula, which are just emerging from long and destructive conflicts, have the lowest per capita GDP while others are relatively better of than South Asia but considerably less so compared to the NICS. There are obvious and significant differences in the strategy of development pursued by different countries. Japan, S. Korea, Taiwan, Singapore are cited as examples of a market driven, export oriented capitalist model with phenomenal success. At the other extreme stands China which, for much of this period, was marked by a near absence of private property and almost complete state control over productive resources and centralised command-type planning. Though such a system is now recognised to suffer from serious defects, and is in the process of being dismantled, the fact remains

that China recorded growth-rates which are high even by NIC standards. In between lies the South Asian countries which have followed the path of planning in the framework of a mixed economy but with considerable degree of state regulation. Their growth rates have been low.

Indicators of living standards in terms of nutrition, health and education also show large differences. East Asia generally is better off than South Asia in terms of calorie intake relative to requirements, literacy rates and life expectancy at birth (table 3). But it is important to note that high standards in these respects do not necessarily go with high levels of GDP per capita. China and Vietnam achieved high levels of health and education even at relatively low per capita incomes as have Srilanka and parts of India. Purposive social policy by way of effective programmes for universal literacy and basic health care along with public distribution and basic food, ensures that basic needs of the masses can be met even at relatively low levels of income. We turn to some of these issues later in this paper.

Some Explanations

The reasons for such differential performances are obviously as varied as they are complex. Theories abound. Explanations range from cultural characteristics to the nature of the State and its policies. High growth rates among East Asian NICs is sought to be linked to the fact that the successful NICs have been united by quasi-Confusian values such as loyalty, respect for elders and a strong work ethics (Chen, 1989). By contrast South Asian societies are much more heterogeneous in terms of language, ethnicity and stratification. Such cultural factors do play a role, possibly an important role. But our understanding is limited and theories tend to be speculative.

Often, it is more useful to focus on the more proximate and measurable factors responsible for the highly differentiated levels of development in Asia. For instance, Ichimura(1993) attributes the relatively fast growth of Japan and other rapidly growing economies of Asia to their high rates of saving and investment, high agricultural growth, availability of an industrious and well educated labour force, quick learning and improvement of foreign/high technology, excellent labour-management relations, adequate fiscal and monetary policies, excellent government industrial policy, counselling of private enterprises by the banks and political stability.

The development in East and South East Asian context has been characterised by several economists as a "flying geese" pattern (Akamatsu, 1962 a: 1962 b: Kojima, 1978) in which one country follows the other in producing and exporting simple labour intensive products and then advancing to more complex products. Why this happened in some countries and not in others, and what accounts for the high rates of accumulation, capacity to master new techniques at a rapid pace and the capacity to absorb adapt and improve on imported technology, cannot be easily explained. Differences in historical conjunctures, the institutional structures and the political conditions are all relevant and must be taken in to account.

The dominant view nowadays accepts open, market driven private enterprise economies with minimal state intervention as the recipe for rapid growth and speedy removal of poverty. This is an over simplification. It is now recognised that none of the success stories of development in Asia is a *laissez-faire* economy. All of them are marked by strong interventionist states. Indeed some see the Japanese miracle as the result of the efforts by bureaucrats in the Ministry of International Trade and Industry (MITI) guiding firms' production and investment decisions (World Development Report, 1991). Since the 1930s at least, Japanese bureaucrats have influenced manufacturer's decisions. They eased their access to capital and foreign technology, granted subsidies, created trade barriers, and given tax breaks on a highly selective basis to promote development of particular sectors, considered as key to long term development. They have formulated plans to allocate production and sanctioned cartels. As influential industrial consultants, MITI's officials fostered a close relationship with the industry.

As influential industrial consultants, MITI's officials fostered a close relationship with the industry.

It is difficult to draw lessons for other countries from an institutional explanation of Japan's or, of NIC's, success except to note that the character of the State and the manner in which it intervened to stimulate growth in these countries is very different from that of South Asia and China. In Japan and NICs, state power was in the hands of a class with a strong commitment to modernisation. State intervention was market-friendly, letting market signals guide production and investment decisions. Instead of interfering with markets, they tried to anticipate the

likely trends. They retreated when they were wrong. The market was still the disciplining factor.

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Productivity Comparisons

Differences in per capita GDP neglect differences in average output per worker. Table 5 gives estimates of GDP per member of the economically active population for two time periods for 13 countries. It shows that Bangladesh has the lowest productivity followed by India, Sri Lanka and Pakistan. Similarly the highest productivity is found in Japan followed by Singapore and Hong Kong. These differences are partly accounted for by the amount of capital used per worker and the quality of labour force (in terms of level of education and training). But it is now well established that these two are not the only factors affecting productivity.

Growth accounting estimates and production function estimates of Total Factor Productivity Growth in manufacturing as a whole are available for a number of Asian economies. Of the set of nine economies for which such estimates are available, India's performance is one of the lowest although China fares only slightly better (table 6). Significantly the four Asian tigers' i.e., Korea, Taiwan, Hongkong and Singapore perform far in excess of their counterparts including China. There is however, no evidence of a positive statistical correlation between mean TFPG and per capita income levels (Ahluwalia, 1991).

Table 5 : Labour Productivity (GDP/Person) in select Asian Countries

Countries	Economically active population (in millions)		GDP in 1985 (US $ mill.)		GDP/Person in (1985US$)		Rate of Growth % per annum
	1981	1990	1981	1990	1981	1990	
Bangladesh	23.6	28.3	11331	16301	480	576	2.00
India	237.6	299.6	156460	253969	659	848	2.87
Japan	56.3	61.5	1191659	1775624	21173	28875	3.51
Rep. of Korea	13.7	16.8	66223	150872	4818	8957	8.59
Pakistan	22.6	28.7	21842	36475	965	1271	3.12
Philippines	15.5	22.0	39312	45426	2535	2064	–1.85
Sri Lanka	5.0	5.6	4833	6760	963	1201	2.47
Thailand	24.6	33.4	30154	60958	1224	1826	4.92
Hongkong	2.4	2.7	26784	47005	11109	17149	5.43
Singapore	1.1	1.3	14364	25914	12908	19562	5.15
Taipei, China	6.7	8.3	47626	94486	7138	11407	5.98
Indonesia	54.1	75.9	73450	118507	1357	1562	1.51
Malaysia	5.0	6.6	25717	42766	5116	6460	2.63

Source : Rows 1-8 compiled from Nair & Suryanarayan, (1993), Rows 9-13 compiled from APO, (1992)

Table 6 : Total Factor Productivity Growth in Manufacturing Sector (percent per annum)

Country	Production Function	Growth Accounting estimates	
		Aggregate	Average of Two-digit
Hong Kong	3.2	—	—
Singapore	3.6	—	—
Taiwan	5.4	—	—
Korea	3.7	3.7	4.5
China	—	–0.2 to 0.7	—
Thailand	—	—	1.5
Philippines	—	—	–0.2
Indonesia	—	—	1.9
India	–0.1	–0.3	–0.2

Source : Ahluwalia, (1991)

Role of the State

It was widely believed that government intervention would promote faster accumulation of capital and rapid economic growth by coordinated and planned use of available resources. The difficulty of coordinating long term investments through the market mechanism arises not only because of its uncertain nature, but also because of the uncertainty created by the decisions, independently

taken or taken in recognition of mutual inter-dependence, by other economic agents which would have a bearing on the success of any investment decision. These uncertainties formed an important justification for socialist planning or central planning by the government (Bagchi, 1987). The choice of planned economic development also was considered to depend on the ability of private enterprise to raise the resources required for investment and also the likely effects on the size of investible resources if the particular project is vested in public sector instead of private hands. The scope of government intervention in economic affairs extends far beyond the running and regulation of public enterprises, in as much as it seeks to alter the pattern of private enterprises which are motivated by their profits rather than by any collective welfare, however vaguely defined. That state intervention is necessary to change the existing distribution of wealth and power is sought to be justified in the interest of social justice.

The scope of government intervention in economic affairs extends far beyond the running and regulation of public enterprises, in as much as it seeks to alter the pattern of private enterprises which are motivated by their profits rather than by any collective welfare, however vaguely defined.

This led governments in many countries to undertake direct investments in infra-structure as well as industry, and regulate the allocation of credit, foreign exchange and other scarce resources. While some (like India) left larger space for private sector, subject to state regulation, others (like China) went considerably farther by practically eliminating the private sector. The legitimacy of state directly taking over most of the economic activities has now come under sustained questioning. It is argued that the poor performance of planned economies is largely the result of excessive government intervention, relying too much on inefficient bureaucracies and public enterprises for developmental activities leaving too little space and freedom for private enterprise to exploit the available opportunities. Further it is also argued that a policy regime which insulates enterprises from the discipline of competition leads to in efficiency.

One of the popular explanations of the rapid growth of NICS (Rep. of China, Rep. of Korea, Hongkong and Singapore) is that they have followed more market oriented and less regulated economic policies than the others; thus, NICs actively encouraging entrepreneurship and private initiative. They also exhibit greater mutual confidence between the government and the private sector. But these economies should not be misunderstood as modern versions of classical *laissez-faire*. They all have had strongly interventionist governments with the difference that the intervention facilitates the operation of the market system. Their governments also intervene for the socio-economic reforms. The ASEAN — 4 countries (Indonesia, Malaysia, Phillippines, and Thailand) also have market oriented policies, though of a lower degree than in the NICs (Naya et.al., 1989).

But these economies should not be misunderstood as modern versions of classical *laissez-faire*. They all have had strongly interventionist governments with the difference that the intervention facilitates the operation of the market system.

Today there is wide and growing support for the view that government's responsibility for directing the production and distribution of goods and services should be significantly reduced. The need for significant state intervention beyond its normal role (maintaining law and order and enforcing contracts) to take up tasks for which markets prove inadequate or fail altogether (e.g., investing in education, health or basic infrastructure) is however conceded (Summers & Thomas, 1993). So is the necessity for the state to intervene to protect the interests of the poor and the vulnerable by giving them work, ensuring access to basic goods and some social security. The question, therefore, is not of replacing state by the market, or of choosing between intervention and *laissez-faire*. This is a popular dichotomy but a false one. The issue is rather of a judicious division of responsibilities between the two and of ensuring that the respective functions are discharged efficiently.

The growing acceptance of this reasoning is reflected in the economic reforms taking place in several countries including China (for over a decade) and India (in the last 2 years). Sweeping economic reform measures were introduced in India two years back and these are being extended progressively. Triggered off by the acute foreign exchange shortage and a galloping inflation in the

The issue is rather of a judicious division of responsibilities between the two and of ensuring that the respective functions are discharged efficiently.

wake of the Gulf crisis, the reforms in India are aimed at cutting down government expenditures on subsidies (food, fertilizers and exports) and keeping a tight rein on the budgetary support for plan programmes. These reforms also seek to liberalise the economy by dismantling government controls on private sector investment, production, imports of inputs, capital equipment and know how; limiting budgetary support for public enterprises and progressively trimming the scope of public enterprises itself (Vaidyanathan, 1992). Restrictions and licensing requirements on import of inputs, capital and know-how have been substantially eliminated. Government has already announced its intention to reduce, over a period of time, tariff levels and rationalise its structure. There are also attempts to evolve ways to ensure higher freedom to employers to hire, fire and redeploy their labour force. These steps are expected to substantially improve the efficiency of the economy and achieve higher productivity in the various sectors of the economy.

Trade Regimes & Productivity

One explanation for the high productivity growth in NICs has been that, despite the extensive government intervention, the trade regimes in these countries have been generally left to be shaped by the market forces. While Hongkong and Singapore are virtual free trade economies, the level of protection in Taiwan has been low, and the tariff levels are lower in South Korea when compared to the slowly growing developing nations of South Asia continent. Table 7 presents the degree of openness among Asian nations. Japan and India show the minimum degree of openness among the Asian nations. It is important that the Japanese case is distinctly different from that of India where excessive governmental regulations reduced the amount of trade. The high quality of the products from the local industries and the level of domestic competition might have caused significant declines in foreign trade in relation to the size of domestic economy in the case of Japan. This shows that developmental strategies followed by Japan and NICs are different. The latter depended mainly on foreign trade as the principal catalyst for development. The characteristics of economic policies in Asian countries are given in table 8. Except in the case of imports, Japan is considered as open. It is clear that the high level of competition within Japan acts as an insulation against foreign entrepreneurs. Therefore, the foreign private investors concentrate on soft areas where they can reap comfortable profits without much local competition.

The trade regimes in these countries have been generally left to be shaped by the market forces.

Table 7: Degree of Openness to Trade

Countries	Export $million 1991	Import $million 1991	GDP $million 1991	Degree of Openness
Hongkong	29738	100255	67555	192.43
Repub. of Korea	71672	81251	282970	54.04
Singapore	58871	65982	39984	312.26
P.R. of China	72875	63791	369651	36.97
Indonesia	28997	25869	116476	47.10
Lao P.D.R	97	228	1027	31.65
Malaysia	34300	35183	46980	147.90
Philippines	8754	12145	44908	46.54
Thailand	28324	37408	93310	70.44
Bangladesh	1718	3470	23394	22.18
India	17664	20418	221925	17.16
Nepal	238	740	3063	31.93
Pakistan	6528	8439	40244	37.19
Sri Lanka	2629	3861	8195	79.19
Japan	314395	234104	3362282	16.31

Note : Degree of Openness is computed using the relation D.O. = (((exp + imp.)/GDP)*100) (Narayana, 1993)
Source : Estimmated from World Development Report, (1993).

The recent report on World Competitiveness identified Singapore as the topper among the Asian Countries (table 9). IMD/World Economic Forum based their competitiveness rankings upon a mixture of hard and soft data (Jebb, 1992). Hard data covered eight criteria. 1. Domestic economic growth. 2. Internationalisation. 3. Government. 4. Finance. 5. Infra-structure. 6. Management. 7. Science and technology 8. People. Soft data came from the findings of the Business Confidence Survey which covered 18000 leading business men in the early spring. Hard data receives twice the weighting of soft data.

It could be argued that the main reason for the NICs to adopt an outward looking policy framework has been

Table 8: Characteristics of Economic Policies in Asian Countries

	Trade		Capital		Finance		Exchange Rate	
	Export Promotion	Import Liberalisation	Permit	Joint Venture	Permit	Loan	Under valued	Flexible
Japan	A	B	A	A	A	A	A	A
Singapore	A	A	A	A	A	A	B	B
HongKong	A	A	A	A	A	A	A	B
Taiwan	A	B	B	B	A	B	B	B
South Korea	A	B	B	B	A	B	B	B
Malaysia	B	B	B	B	A	B	B	B
Thailand	B	B	B	B	A	B	B	B
Philippines	B	B	C	C	C	C	C	C
Indonesia	B	B	C	C	B	C	B	B+
China	B	C	C–	C–	C–	C–	C	C
India	B	C	C–	C–	C–	C–	C	C
Sri Lanka	C	C	C–	C–	C–	C–	C	C
Pakistan	C	C	C–	C–	C–	C–	C	C
Burma	C	C	C–	C–	C–	C–	C	C
Nepal	C	C	C–	C–	C–	C–	C	C
Bangladesh	C	C	C–	C–	C–	C–	C	C

Note : Permit (Capital) : Permit for establishing foreign companies; Joint Venture: Percentage of Foreign partners in joint ventures; Permit (Finance) : Permit for borrowing from foreign sources; Loan : Amount to be borrowed; A=satisfactors; B=slightly restrictive; C=very restrictive· C– = extremely restrictive

Source: Ichimura, (1993)

Table 9: Ranking of Asian Countries for 1991 and 1992

Countries	Over all	Domestic eco. Stren.	Internation-alisation	Govt.	Finance	Infrastruc-ture	Manage-ment	Scienc & tech.	People
Singapore	1(1)	1(2)	1(1)	1(1)	1(2)	1(5)	1(1)	2(3)	1(1)
Taiwan	2(4)	3(3)	3(2)	4(4)	5(4)	6(6)	3(6)	1(2)	3(3)
Hongkong	3(2)	5(5)	2(3)	3(2)	2(1)	3(3)	2(2)	4(5)	5(5)
Malaysia	4(5)	6(4)	5(5)	2(3)	3(3)	5(1)	4(4)	6(6)	4(2)
Korea	5(3)	2(1)	6(4)	6(6)	6(7)	2(4)	5(3)	3(1)	2(4)
Thailand	6(6)	4(6)	4(6)	5(5)	4(6)	7(7)	6(5)	7(7)	6(6)
Indonesia	7(7)	7(7)	8(7)	7(7)	8(5)	6(6)	8(8)	7(8)	8(7)
India	8(8)	8(8)	9(8)	8(8)	7(8)	8(8)	7(7)	8(4)	7(8)
Pakistan	9(—)	9(—)	7(—)	9(—)	9(—)	9(—)	9(—)	9(—)	9(—)

Note: Figures in bracket corresponds to 1991 ranking : Pakistan is new to the report in 1992

Source: Compiled from Jebb, (1992).

that their markets were smaller in size to render the import substitution policies untenable, unlike the case of resource rich countries like India and China. By and large, the South Asian economies allowed their industries to hide behind high tariff walls. The large profits that were earned by the inefficient producers in these countries led to the creation of special interest groups supporting the continuation of such policies. These policies sustained overvalued exchange rates which discriminated against exports of manufacturers. Many of these economies particularly from South Asia are dismantling their trade regimes which are characterised by high tariff walls.

These policies sustained overvalued exchange rates which discriminated against exports of manufacturers.

The best known argument linking trade regimes with productivity is that the returns to entrepreneurial effort increases with exposure to foreign competition (Tybout, 1992). The main difficulty is in that, scale economies can cut both ways. When domestic firms enjoy market power, extra competition from foreign producers can force them to expand or exit. Thus, the net effect of liberalization on productivity depends upon the specifics of the demand shifts that accompany liberalisation, ease of entry or exit and the nature of competition (Corden, 1974).

Changes in trade regimes can also affect the links between domestic and international markets and generate suspicions about their sustainability. The uncertainty effects arising from trade reforms can influence productivity unfavourably also. For example when the incentive structure changes frequently and unpredictably, entrepreneurs are reluctant to incur the sunk costs of retooling (Krugman, 1986). Similarly, when substitution possibilities exist, managers may react to uncertainity by choosing labour intensive technologies although advanced technologies would have been less costly if market conditions were stable (Lambsen, 1989). Rapid and efficie'nt adjustments in productive capacity are likely only when trade reforms establish a credible, stable regime (Tybout, 1992).

Rapid and efficient adjustments in productive capacity are likely only when trade reforms establish a credible, stable regime.

Trade regimes can also be positively linked to rates of diffusion and innovation. For instance, a firm's market share can affect the pay off it reaps from adapting new technologies. Trade reforms may therefore reduce the catch-up rate to international productivity levels in import competing sectors and accelerate among exportables (Rodrick, 1992). Normally, the new processes diffuse through an industry as entrepreneurs learn about them and older vintage machines depreciate. Under such circumstances productivity growth cannot be an orderly shift in technology. The process of learning, innovation, investment, exit etc., is affected by trade orientation through many channels, often by influencing entrepreneur's ability to monitor new technological developments, or by changing the expected returns (Stewart & Ghani, 1992).

When deciding whether to develop new products, entrepreneurs consider the variety of substitute products already available, which depends, in turn, upon their exposure to international competition and the ease with which the knowledge crosses international boundaries. The significant point to note here is that liberalisation towards a free trade regime need not be a panacea for all the economic ills of any nation in the short run; more so because such ills have roots in the past policies. On the contrary, there can even be temporary set backs in macro variables like employment, growth, balance of payments etc. The success of these efforts in the long run, however, depends on the effectiveness of their implementation through carefully chosen policy variables.

The main argument is for using trade policy as a strategic tool to give domestic firms an edge in global markets. When large oligopolies compete in world markets, governments might want to subsidize domestic firms to shift oligopoly profits to them. Similarly, a government could try to subsidize the entry of national firms into global markets with scale economies that preclude more than a few players (World Development Report, 1991). Selective state intervention has figured prominently in two of the impressive success stories of development: Japan and the Republic of Korea. Both the countries employed taxes and subsidies, directed credit, restrictions on firm entry and exit, and trade protection to encourage domestic industry. Evidences suggest that countries do better if the interventions result in neutral incentives. Success also depends on a time limit for interventions.

Selective state intervention has figured prominently in two of the impressive success stories of development: Japan and the Republic of Korea.

Intra-Regional Trade

To some extent the dynamism of intra-regional trade seemed to have played a key role in helping to shelter the economies of Asian region from the slumber in the world economies in recent years. The Chinese dynamism is particularly evident in intra-regional trade growth in Asia (table 10). Developing Asian Countries' exports to China increased by a staggering 30% in 1991. Advantages due to intra-regional trade may assume an increasingly important source of growth in Asian economies, provided policy frameworks are adequately adapted to facilitate such trade among them.

Table 10: Matrix of Intra-Asian Exports : 1991 ($million)

From\To	China	NIEs	Southeast Asia	South Asia	DMCs	Japan	World
China	—	36300	2140	1381	39844	10265	70451
NIEs	27901	41704	24875	4249	99041	32092	307819
Southeast Asia	2392	23343	4519	1492	31807	23640	102420
South Asia	285	2731	1223	812	5057	2700	28527
DMCs	30594	104243	32825	7938	176006	69119	511014
Japan	8605	66928	25593	3602	105006	—	314786
Percent change							
From\To	China	NIEs	Southeast Asia	South Asia	DMCs	Japan	World
China	—	22.6	15.9	12.6	21.8	11.5	15.0
NIEs	32.0	25.8	17.7	0.3	23.9	6.4	15.6
Southeast Asia	30.3	22.4	11.7	–1.1	20.0	9.6	16.9
South Asia	88.3	41.1	66.3	–10.4	35.6	16.9	2.8
DMCs	32.3	24.2	17.9	0.7	23.0	8.5	14.8
Japan	40.0	17.8	13.9	0.8	17.5	—	9.5

Source: Asian Development Outlook (1993)

In recent years there appeared considerable interest in economic regionalism facilitated by the emergence of the European Community and the North American Free Trade Agreement (NAFTA). The latter has been an important development because of the abruptness with which it emerged and also because it included the United States. The Association of South East Asian Nations (ASEAN) founded in 1967 contributed to the prevention of political and military tensions in the area, although the South Asian Association for Regional Cooperation (SAARC) founded in the eighties is yet to achieve such a success. Efforts at regional co-operation are significant because they can enable achieving better contacts, secure information and ensure channels of communication which reduce transaction costs and increase the stock of 'information capital'. Such invisible stocks of trust or information capital can be very valuable in the context of productivity growth.

Efforts at regional co-operation are significant because they can enable achieving better contacts, secure information and ensure channels of communication which reduce transaction costs and increase the stock of 'information capital'.

Regional economic integration, very often, faces the problem of intra-regional trade expansion being limited by the lack of complementarity of the export structures of the trade partners. The issue of changing the structure of production to allow for greater trade is central to regional integration councils. Nations are competitive in clusters of linked industries, which are often highly localised (Michael, 1992). Most economies have a large number of highly localised industries; for instance, motion picture (Hollywood), financial services (Wall Street), and auto (Detroit) industries in the US. Economies grow and develop through the formation of industry clusters. Clusters allow firms and nations to develop high technology industries out of the more traditional ones. Competitive advantage is often highly localised within the regions, cities or even parts of cities. Despite globalisation of industry and improvements in information technology, spill over of advanced, and detailed knowledge and information appear to be intensely localised. Close coordination of policies towards education, training, and infrastructure, as well as management of relations with local firms, is often best done by local authorities. Local authorities should have a substantial degree of autonomy in working for regional development.

Foreign Direct Investments

Recent economic and political developments have raised concerns among developing countries about the availability of international capital flows. There are also concerns that capital flows to developing countries may be affected by new demands from Eastern Europe and the former Soviet Union. In terms of official finance, especially official development assistance (ODA), there may be valid reasons for concerns, however (Collins, 1992). Empirical analysis of past experience suggests that large

sustained increases in aid to selected countries tend to divert substantial flows from other developing countries. Table 11 shows the sources of net resource flows to developing countries during the past decade, including net foreign direct investments, net unrequited (unrepaid) transfers, net lending from official and private sources, and changes in arrears. In 1987, after years of decline, net resource flows to developing countries began rising. Although by 1990 they had increased by more than 30 percent (in real terms), the total was still just 73 percent of 1982 levels.

Table 11: Net Resource flows to Developing countries 1982-90 (billions of US dollars)

Years	Official Development Finance	Export credits	Private flows	Nominal total	Real total
1982	44.1	13.7	58.2	116.0	175.6
1983	42.4	4.6	47.8	94.8	144.4
1984	47.5	6.2	31.7	85.4	133.7
1985	48.6	4.0	30.5	83.1	128.9
1986	55.8	–0.7	26.7	81.8	100.6
1987	61.5	–2.6	33.7	92.6	98.2
1988	65.5	–2.1	43.8	107.2	105.8
1989	65.5	9.5	48.3	123.3	123.3
1990	78.8	4.6	60.8	144.2	128.9

Source : Collins, (1992)

The private sector in the West seems to show little willingness to invest large amounts in the region in the face of political and economic uncertainties, including the lack of legal protection for property rights. Even successful institutional transitions seem to take years to develop. For instance, in India entry restrictions for investors were, by and large, removed as a part of the ongoing economic reforms, the freedom to exit remains a contentious issue, defying any consensus even in national level debates, leave alone arriving at a final solution.

Even successful institutional transitions seem to take years to develop.

Large Foreign Direct Investment inflows to the DMCs continue to be associated with the region's economic dynamism. For the 12 developing countries listed in table 12, FDI inflows increased by 11.8 % in 1991, down from 17.5 % growth in 1990. In view of the shrinking assistance from ODA sources foreign direct investment is likely to assume an increasingly important role in the coming years in the case of developing countries of Asia. Besides, there are specific advantages for foreign direct investments, particularly in the context of technology transfer and management.

Import of Technology & Productivity Growth

In the early stages of development the accumulation of technology is influenced by factor endowments and

Table 12: Foreign Direct Investment in selected DMCs

	1986	1987	1988	1989	1990	1991	1986-1991
NIEs	2471	4152	5485	5132	5906	5971	29117
Korea	435	601	871	758	715	1116	4496
Singapore	1710	2836	3655	2770	3861	3584	18416
Taipei, China	326	715	959	1604	1330	1271	6205
China	1875	2314	3194	3393	3489	4366	18631
Southeast Asia	1137	1467	3336	4688	6581	7494	24703
Indonesia	258	385	576	682	1093	1482	4476
Malaysia	489	423	719	1668	2514	3454	9267
Philipines	127	307	936	563	530	544	3007
Thailand	263	352	1105	1775	2444	2014	7953
South Asia	345	373	521	580	402	556	2777
Bangladesh	2	3	2	..	3	1	11
India	208	181	287	350	112	200	1338
Pakisthan	105	129	186	210	244	257	1131
Sri Lanka	30	60	46	20	43	98	297

Source : Asian Development outlook, (1993)

intersectoral linkages. In the later stages the level of technological knowledge itself can become a source of comparative advantage, reflected in production know-how, the design of capital goods, and a capacity for reverse engineering and imitative research and development. Evidence shows that firms play a central role in this process and that, production capacity does not lead automatically to technological capabilities in developing countries (Bell & Pavitt, 1993).

Empirical studies on the technology — productivity nexus carried out for the American industries by Griliches (1984) and others showed that technological advancement is a major source of productivity improvement. These studies have brought out that the rate of improvement in productivity achieved by a firm or an industry depended crucially on the R&D efforts of the firm/industry and that the flow of new advanced technology embodied in intermediate inputs and capital goods resulting from the R&D efforts of input suppliers. Similar conclusions have also been reached in the studies of Odagiri (1985) for Japanese industries and Cuneo & Mairesse (1984) for French industries.

While there has been a significant inflow of advanced technology into Indian Industries over the last four decades, there has been no appreciable improvement in industrial productivity (Goldar, 1993). Studies indicated that the application of imported advanced technologies in Indian Industry did not result in any substantial gains in resource-use efficiency. While technology import enabled Indian firms to carry out profitable operations, it rarely prepared them to undertake innovative activities. The failure of Indian industry to take adequate advantage of technology imports has been attributed to low volumes of operations (small size of the domestic market), the government imposed phased manufacturing programmes, low R&D intensity of domestic manufacturing firms and slow progress in the development of indigenous capabilities. The solution does not appear to be merely technological but largely institutional. The speed with which the policies work in one sector is often determined by what happens in other sectors. (Vaidyanathan, 1992). Since the early 1980's considerable emphasis has been placed on technology upgradation and productivity improvement in Indian industries. The new economic policies discourage industrial fragmentation and encourage establishment of plants of economic size.

The speed with which the policies work in one sector is often determined by what happens in other sectors.

The international knowledge system is complex and unequal. The means of knowledge production and distribution are both centralised. The bulk of the world's R&D expenditures has been made by a small number of industrialised countries (table 13). Developing nations account for under 10 percent of the world's total R&D expenditure. The US, the European Community and Japan dominate. Russia (the former Soviet Union), a one time research power, is no longer much involved in reasearch at the international level. Both basic and applied research are dominated by the major industrialised countries. Basic science depends on funding from governmental sources, the existence of a large and well

Table 13: R&D Expenditure in Selected Countries (billion US $)

		Japan	US	USSR	Germany	France	UK
1975	Expenditures	15.5					
	% nat.income	2.1					
	% pub.funds	27.5					
1980	Expenditures	27.8	62.6				
	% nat. income	2.4	2.6				
	% pub.funds	25.8	47.1				
1985	Expenditures	48.2	107.4				
	% nat.income	3.2	3.0				
	% pub.funds	19.4	47.7				
1990	Expenditures	9.0	156.7	61.7	34.5	30.8	19.4
	% nat.income	3.5	3.3	..	3.7	2.6	3.0
	% pub.funds	16.5	44.0	46.8	33.2	47.9	36.5

Notes : USSR figures are for 1988, German and UK figures are for 1989
Source : Ichimura, (1993)

trained academic scientific community based in universities and a competitive scientific culture that stresses productivity advancement and prestige. Basic science also depends increasingly on net-working — the personal and professional contacts that are helpful to scientific advancement. The scientific communications system is also centralised and dominated by the major research producing nations. While there are between 60000 and 100000 scientific journals world wide, only about 3000 are indexed by the Institute for Scientific Information (ISI), which keeps track of significant internationally circulated science (Altbach, 1993).

It is clear that developing countries are at a particular disadvantage. Not only are their scientific systems generally small and poorly equipped, but they do not have easy access to the communications networks also. Since the transfer of first generation technology from the developed countries to developing countries seems a remote possibility, the deprived nations particularly from Asia, may consider a consortium initiative to undertake basic research activities with the active help of non resident Asians working abroad. Such an approach seems to be particularly relevant to the developing countries in Asia in the wake of the recently aborted cryogenic technology deal between India and Russia and such similar other examples. In terms of the number of qualified scientists and researchers, India and China are considered the third world's scientific superpowers. Yet, these two countries are, and will remain, peripheral in the world scientific system (Philip, 1993).

Scienfic and technological developments in the world will continue to be dominated by the West and Japan for some time to come. The industrialised nations simply have such large scientific infrastructures and spend so much on R&D that it is not possible for developing countries to catch up. It is not possible to opt out of the system — China tried this during the cultural revolution to its great detriment (Philip, 1993). Therefore, an important part of a successful strategy to make the best possible use of its own academic and scientific resources may be co-operation among countries which are in similar positions. Regional forums such as ASEAN, SAARC etc., could be activated to achieve the required results. Intergovernmental organisations such as the APO, and local organisations like the NPOs can act as a via media between transfer of available technologies and their indigenisation to the local situation. To some extent the efforts of the productivity organisations in Asian countries helped to achieve this goal; far more remains to be done. A successful illustration of a government's determination to promote R&D and to evolve active intermediaries for technology development is offered by the Korean Institute of Science and Technology (KIST) which was started with American help towards the middle of the sixties, and which is today an outstanding example of not only purposive and successful technology transfer from developed to developing context, but also in evolving local R&D interests and objectives and implementing it with required determination (Choi, 1993)

Inter-governmental organisations such as the APO, and local organisations like the NPOs can act as a via media between transfer of available technologies and their indigenisation to the local situation.

Industrial Restructuring

Japanese experience shows that economic development cannot be achieved without taking into account two critical factors. First, the manufacturing industry should be the basis of development. Second, industrial development cannot be achieved without the involvement of small industry (Ohnishi, 1992; Yu, 1993). Sony, Toyota, NEC, Hitachi, etc., have earned their reputation as leading firms in the international market, but their competitiveness is largely derived from the highly developed subcontracting systems in which small firms provide materials, parts and components, or semi finished products to parent firms.

The Japanese subcontracting has been criticised as being a closed economic system which does not allow foreign participation resulting in market monopoly by Japanese industries. That large number of subcontracting firms became independent and technology-oriented was attributed to a kind of entrepreneurship in response to the strong and sometimes unreasonable pressures from parent firms. Hence these pressures were blessings in disguise to them. They were able to assimilate, adapt, modify, improve and develop technologies to the extent that they became fully competitive in the domestic and international markets. It is interesting to note that subcontracting firms in Japan have gradually strengthened their independence from captive type to multi-transaction type relationships. The partnership has become increasingly closer to free market rather than organized market in the light of long-accumulated mutual confidence and joint work as well as profit sharing between the parent and sub contracting firm. Less advanced Asian com-

petitors may gain by assimilating the Japanese experience in industrial restructuring towards strengthening the competitive forces to accelerate the process of industrial expansion. Experience shows that such restructuring cannot take place without a firm resolve from the respective national governments not only by creating a suitable climate but also arranging for the institutional mechanisms (financial, technological) without the involvement of which individual organisations, whether small or big, parent unit or the subcontractor are unlikely to establish longstanding and stable business transaction arrangements.

Investment in Human Resources

Table 14 shows that the investments in human capital has been reasonably satisfactory in most Asian countries. Majority of workers in these countries now have secondary education, and there are enough middle managers and engineers to facilitate the transfer of higher technologies (Ichimura, 1993). In many East and South East Asian countries the spread of secondary education is so wide that most factories have no difficulty employing workers with such education. As a result, the transfer of technology has become a lot more easier including the introduction of such devices as Quality Circles is possible with no difficulty in Asian NICs. In South Asia, only Sri Lanka and Burma had made such extraordinary educational efforts and thereby achieved high human development indicators.

Investments in human capital has been reasonably satisfactory in most Asian countries.

In addition to the improvement in the health of workers another important contributor to the improvement of quality of life in the region is the decline in the fertility rate in most Asian countries (table 15). For obvious and wellknown reasons, human resource developement is an indicator of the level and quality of social and economic infrastructure that facilitates faster and healthier development of populations. Based on an analysis of cross country experiences, the Human Development Report (UNDP, 1990) draws several important conclusions. First, growth accompanied by an equitable distribution of income appears to be the most effective means of sustained human development (eg. South Korea). Second, countries can make significant improvements in human development over long periods - even in the absence of high income growth and good distribution — through well structured social expenditures by government (eg. Sri Lanka, Malaysia). Third, well structured government so-

Table 14: Indexes of Social Development in Asian Countries (%)

	Literacy		Newspaper subscriptions		Primary Education		Secondary Education		Higher Education	
	1970	1985	1970	1985	1965	1985	1965	1982	1962	1985
HongKong	77	88	498	560	103	105	29	69	5	13
Repub. of Korea	88	96	136	192	101	96	35	94	6	32
Singapore	72	86	200	279	105	115	45	71	10	12
Taiwan	85	92	—	—	98	100	59	80	8	18
P.R. of China	43	69	—	19	89	124	24	39	0	2
Indonesia	57	74	—	14	72	118	12	39	1	7
Malaysia	58	73	75	173	90	99	28	53	2	6
Philippines	83	86	14	37	113	106	41	65	19	38
Thailand	79	91	20	52	78	97	14	30	2	20
Bangladesh	23	33	—	6	49	60	13	18	1	5
India	33	43	16	19	74	92	27	35	5	9
Myanmar	66	81	9	14	71	102	15	24	1	4
Nepal	13	25	2	7	20	79	5	25	1	5
Pakistan	21	29	—	18	40	47	12	17	2	5
Sri Lanka	78	87	49	106	93	103	35	63	2	5
Japan	99	99	520	569	100	102	82	96	13	30

Source : Ichimura, (1993)

Table 15: Fertility, Child mortality, life expactancy at birth, level of immunization and per capita health Expenditure

Countries	Total fertility rate 1990	Child mortality rate 1990	Life Expe.ancy at birth 1990	% of children immunised age < 1 1990-91	% of children immunised age < 1 1990-91	Per cap. health expenditure in dollar 1990
Hongkong	1.5	7	78	83	42	699
Repub. of Korea	1.8	10	72	74	93	377
Singapore	1.9	8	74	91	92	219
P.R. of China	2.5	43	69	95	96	11
Cambodia	4.6	174	50	38	38	..
Indonesia	3.1	111	59	86	80	12
Lao P.D.R	6.7	171	50	22	47	5
Malaysia	3.8	20	71	90	79	67
Philippines	3.6	62	64	88	85	14
Thailand	2.4	36	68	69	60	73
S.R. of Vietnam	3.9	46	67	85	85	2
Bangladesh	4.6	137	56	87	83	7
India	4.0	127	58	83	77	21
Myanmar	3.9	101	61	69	73	..
Nepal	5.7	135	56	74	63	7
Pakistan	5.9	139	56	81	77	12
Sri Lanka	2.4	22	72	86	79	18
Japan	1.6	6	79	87	66	1538

Source : Compiled from World Development Report, (1993).

cial expenditures can also generate fairly dramatic improvements in a relatively short period of time. Fourth, to maintain human development during recessions and natural disasters, targeted interventions may be necessary. Fifth, growth is crucial for sustaining human development in the long run otherwise human progress may be disrupted. Sixth, despite periods of rapid GNP growth, human development may not improve significantly if the distribution of income is bad and fiscal expenditures are low or appropriated by those who are better off.

The main instruments of governments for directly affecting the human development are : (1) Across the board policies, provision of public goods and services in a way that does not discriminate among different soical groups or regions (e.g., universal food subsidy systems, universal primary education programmes and nation wide immunisation programmes). (2) Targeted policies; provision of public goods and services to all members of particular target groups in the society (e.g. the food subsidy programme for lower income groups or a supplementary feeding programme that cover all mal-nourished children). Such policies centre on health, education, potable water and other social services and can be measured by the shares of government spending on them in GNP or GDP. The Human Development Report (1990) considers such efforts as low if government expenditures on social sectors are less than 6 % of GDP, moderate if they are between 6 % and 10 % and high if they are greater than 10 %. Significantly, there can be different types of expenditures within each social sector such as that on primary or tertiary education and on preventive and curative health care. Spending on primary education and preventive health care is itself to lead to substantially larger improvement in human development than spending on higher levels of education and curative health care.

Spending on primary education and preventive health care is itself to lead to substantially larger improvement in human development than spending on higher levels of education and curative health care.

Impact of Migration in Asian Countries

The challenge for Asian Policy makers is how best to utilise the incomes the migrant workers remit and the

skills they bring home. A recent ILO-ARTEP study 'To the Gulf and Back', stresses that overseas migration in Asia needs to be incorporated in to the macro-economic planning "rather than simply be used as manna from heaven" like it was in the past. "The realisation that return migrants be viewed as a potential asset — a package of labour skills, experience and investible resources — which can be tapped for the benefit of the economy has unfortunately been very slow to sink in among policy makers", it says. This study also predicts that the migrant levels to the Middle East will stabilise. Total migration is expected to be about 30 percent lower in 1990 than in the mid 1980s when annual out flows averaged roughly 750000 workers. The Middle East will continue to depend on imported labour for some time although the skills sought will shift, particularly from construction to service industries. With nearly two decades of experience behind them, planners should be prepared to maximise benefits from future flows out of Asia's labour exporting nations — Pakistan, India, Sri Lanka, Bangladesh, Thailand, the Philippines, the Republic of Korea and Indonesia. This study estimates that in 1987 there was still 3.2 million Asian workers in the Middle East.

The realisation that return migrants be viewed as a potential asset — a package of labour skills, experience and investible resources — which can be tapped for the benefit of the economy has unfortunately been very slow to sink in among policy makers.

Given the underemployment and unemployment in almost all the labour exporting countries, the migration has no obvious unfavourable impact on economic growth. Indeed it acted as a "safety valve" when most faced serious recession in the late 1970s and early 1980s. During the first half of eighties remittances were large enough to finance as much as 40 percent of India's massive balance of trade deficit. Pakistan's migrant workers reportedly sent home $ 2.5 billion in remittances during 1982-83. The Republic of Korea gained more than $ 1.9 billion in 1982 from its migrant workers. The Philippines eventually became the largest Asian labour exporter with some 500000 of its citizens in the Middle East by 1983 and close to $ 1 billion in annual remittances.

Apart from out migration, nations can also resort to internal migration as has been observed in China for mitigating poverty. Substantial Chinese achievement in economic development is mainly due to the implemenation of a conscious inter and intra-regional migration of its labour force. An important characteristics of migration as a contributor to reduction of poverty is that it is a relatively costless strategy for the national governments. Innumerable studies on migration show the large initial propensity of young single migrants to send back a large portion of their earnings to their families in their native place. To date, much of the largest amount of long distance migration out of poor areas in China under the economic reforms has been seasonal. The net balance of advantage of this form of migration is almost certainly positive both for individual families and for the poor regions as a whole (Nolan, 1993). Unlike the situation in most other developing countries, a segment of long-distance migration from poor areas in China went through official channels. Local authorities, especially township governments, in poor areas often helped organise migrants, giving them training courses and information about job opportunities, based on the belief that their migration would benefit the local community. Moreover, the Central Government has played a key role in organising long-distance migration in poor areas, though the bulk of this has been within provincial boundaries. This is yet another instance of development bureaucracy's positive contributions to promotion of growth in the Asian region.

Environment & Productivity

Now a days most of the developmental efforts are becoming environmentally sensitive which national governments undertake in the developing nations. Therefore, it is inevitable to strike a balance between impact of environmental problems and the developmental schemes. This forces nations to seek substantial environmental impact assessment studies and undertake remedial measures before commencing the projects to minimise the damage both to the nature and man. Till date it was not in the active agenda of policy makers to streamline developmental efforts within a sustainable developmental model. In India also such issues are surfacing, now and then, hindering the implementation of giant projects such as Narmada Hydel Project, and Super Thermal Power Stations. In hindsight, this indicates the insufficient thinking and preparedness on the environmental questions at the project conceptualisation stages. In the coming years this is likely to be a major concern to policy makers in Asian countries for finding out acceptable solutions towards an environment friendly sustainable development pattern and thereby improve general productivity levels.

Conclusions

Liberalisation of foreign trade, opening the door to private foreign investment, dismantling of controls on private sector, and reducing the scope of the public sector through privatisation are among the most widely discussed elements of the on going reforms in several countries. They are expected to generate significant pressures, on enterprises to improve efficiency and quality. At the same time liberalisation gives much wider scope and freedom for enterprises for cutting costs and improving quality. By redressing the imbalance between export and import substitution, the reforms are expected to encourage a pattern of production and technology choice consistent with each country's comparative advantage. All this should in principle lead to higher overall efficiency in resource use.

It is important to ask whether the response in terms of speed and magnitude will be the same across sectors. What more needs to be done to stimulate a larger and faster response in terms of more effective use of resources?. Are these measures *per se* adequate to stimulate faster growth of agricultural productivity and raise the efficiency of the public sector?. The Chinese experience suggests that a relaxation of price controls and compulsory procurement of produce by the state evoked a dramatic response in terms of reported output growth. But in countries like India there are relatively few price controls and compulsory procurement at fixed price is unimportant. Relaxation of controls on foreign trade and changes in the pricing policy for inputs are likely to be far more important. But this alone may not make a significant difference to productivity growth unless accompanied by more and better planned investments in irrigation and land improvement, measures to make extension and research more efficient, and major changes in the institutional arrangements for managing common productive resources like land and water.

Efficiency improvements in a more liberal and competitive environment will occur among firms which are motivated and judged by the profits they make. This is a reasonable characterisation of private enterprise but not of public agencies including public enterprises. Liberalisation *per se* is unlikely to lead to greater efficiency in the public sector; nor a mere hardening of the budget constraint' (by putting a limit on the extent to which their losses will be borne by the budget and on the extent of financing they can get for fresh investments from the budget) can be expected to make these enterprises efficient. The efficiency of public agencies depends critically on the extent of autonomy given to management, the way the agencies are structured and manned, the mechanism for internal coordination and incentive systems within enterprises. It also calls for external pressures by making approvals of price increases contingent on an independent public review of efficiency in production. The practice of making enterprises bear the burden of social obligations considered important by government must also disappear. Action to control these deficiencies goes far beyond the liberalisation packages. A better understanding of the ingredients of the necessary reform from the experience of countries which have achieved a high level of efficiency in public utilities and infrastructures both of which figure prominently in public sector activities, thus needs to emerge.

Action to control these deficiencies goes far beyond the liberalisation packages.

Even in the sphere of foreign trade and private industry where trade liberalisation and freer markets would make the greatest impact, the creation of an incentive environment is a necessary but not sufficient a condition for making the potential for improvement: more exports require organisations to get reliable and prompt information on the condition of the markets, changing fashions and technologies, to cultivate promising markets and develop the capability to adapt to the market demands. More generally, improvement in industrial productivity requires the services of specialised and expert organisations to work out productivity improvement measures appropriate to particular industries and individual units. Often improvements in one sector cannot exploit the full potential unless the operations of sectors providing the inputs are also improved. All this is typically the role of the productivity organisations whose experience can be fruitfully shared in order to make macro-policy reforms readily effective.

Acknowledgements

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References

Ahluwalia, Isher Judge., 1991, *Productivity and Growth in Indian Manufacturing*, Oxford University Press, Oxford.

Akamatsu K (1962.a) "A historical Pattern of Economic Growth in Developing Countries". *The Developing Economies*, Preliminary Issue No.1. March-Aug.

Akamatsu K (1962 b) "A Theory of Unbalanced Growth in the World Economy". *Weltvirtsehaftiches Archio* Vol. 86, No. 2 quoted in Naya et.al (1989).

Asian Development Outlook (1993), *Asian Development Bank*, Oxford University Press.

Asian Productivity Organisation, (1992), *Comparative information on Productivity levels and changes in APO member countries*, Tokyo, Japan.

Bagchi, Amiya Kumar, (1987), *Public intervention and industrial restructuring in China, India and Republic of Korea*, ILO-ARTEP, New Delhi.

Bell, Martin & Keith Pavitt, (1993), "Accumulating Technological Capability in Developing Countries", in *Proceedings of the World Bank: Annual Conference on Development Economics 1992.*

Chen, Edward. K.Y., (1989), *Trade Policy in Asia*, in Naya et.al., (ed.) (1989).

Choi, Hyung Sup. (1993), *Role of Technology for Higher Productivity & Development*, Foundation Day Lecture, National Productivity Council, New Delhi, February 17.

Collins, Susan M., (1993), "Capital Flows to Developing Countries: Implications from the Economies in Transition", in *Proceedings of the World Bank: Annual Conference on Development Economics 1992.*

Corden, Max (1974), *Trade Policy and Economic Welfare*, Oxford - Clarenden Press.

Cuneo, P. & Mairesse, J. (1984), *Productivity and R&D at the Firm level in French manufacturing*, in Z.Griliches (ed.) (1984).

Fiona Jebb, (1992), "World Competitiveness Report : The four ages of National Competitiveness", *World Link* (The Magazine of the World Economic Forum), July-August.

Goldar, Bishwanath, (1993), "Import of Technology & Productivity Growth in Indian Industry", *Productivity*, Vol. 34, No.1, April-June.

Griliches, Z., (ed.) (1984), *R&D, Patents and Productivity*, University of Chicago Press, Chicago.

Ichimura, Shinichi. (Ed.), (1988), *Challenge of Asian Developing Countries : Issues and Analysis*, Asian Productivity Organisation, Tokyo, Japan.

Ichimura, Shinichi. (1993), "Policies for Economic Development", *APO Productivity Journal*, Spring.

Kajima K. (1978), *Direct Foreign Investment: A Japancee Model of Multinational Business Oputions*, Praeger, Newyork.

Krugman, Paul (1986), "New Trade Theories and the Less Developed Countries", in G.Calvo, (ed) *Debt Stabilization and Development*, Basil Blackwell.

Lambson, V.E., (1989), "Industry Evolution with Sunk Costs and Uncertain Market Condition", *SSRI Working Paper*, 8904, University of Wisconsin - Madison, Quoted in Tybout (1992).

Michael. J.Enright, (1992), "The Competitive Edge : Why local Clusters are the way to Win the Game", *World Link* (The magazine of the World Economic Forum), July-August.

Nair, N.K. & K. Suryanarayanan, (1993), "Labour Productivity in Select Asian Countries", *Productivity*, Vol. 33, No.4, January-March, 1993.

Narayana, M.R. (1993), "Export Competitiveness, Taxes and Domestic Welfare in India: Some new empirical evidence", *Productivity*, Oct-Dec 1993.

Naya, Seiji; Higual, Urruta; Shelly, Mark & Alfredo, Fuentes, (1989), *Lessons in Development : A Comparative study of Asia and Latin America*, International Centre for Economic Growth.

Nolan, Peter., (1993), "Economic Reform, Poverty and Migration in China", *Economic and Political Weekly*, Vol. XXVIII, No.26, June 26, 1993.

Odagiri, H. (1985), "Research Activity, Output Growth and Productivity Increase in Japanese Manufacturing Industries", *Research Policy*, Vol.14.

Oshnishi, Yoshikuni, (1992), "Industrial Restructuring : Subscontracting in Japan", *Productivity*, Vol. 33, No.2, Jul-Sept.

Philip. G. Altbach, (1993), "Gigantic Peripheries : India and China in World Knowledge System", *Economic and Political Weekly*, Vol.XXVIII, No.24, June 21.

Rodrick, Dam (1992), "Closing the Technology Gap : Does Trade Liberalization Really Help?", in G. Helleimer (ed.) *Trade Policy Industrialization and Development*, Oxford - Clarenden Press.

Stewert, Frances & Ejas Ghani (1992), "Externalities, Development and Trade", in G.Helleiner (ed.), *Trade Policy Industrialisation and Development*, Oxford - Clarenden Press.

Summers, Lawrence H. & Vinod Thomas, (1993), "Recent Lessons of Development", *The World Bank: Research Observer*, Vol.8, No. 2, July 1993.

Tybout, James, R., (1992), "Linking Trade and Productivity : New Research Directions", *The World Bank Economic Review*, Vol.6, No. 2.

UNDP (1990), *Human Development Report.*

Vaidyanathan. A, (1992), "Productivity and Structural Adjustment", *Productivity*, Vol.33, No. 2, July-Sept.

Venkataratnam, C.S. (1993), "Impending Events : A Global Industrial Relations Perspective", *Productivity*, Vol. 34, No.1.

World Development Report, 1992.

World Development Report, 1993.

Yu, Jisoo, (1993), "Keiretsu Relationship in Japan — Its Lessons", *Productivity*, Oct-Dec. (Forthcoming). □

Special Report

Government Policy, Economic Development & Productivity in Republic of China

Kao-Chao Lee

The emergence of the Republic of China (ROC) in the World economic scene is widely held as a miracle. The government policies in the ROC has played an overwhelmingly important role in the transformation of Taiwan from an underdeveloped backward country in to a highly modernised industrial economy. This paper presents an introduction to these policies and assesses their impact on a economic development and productivity.

Kao-Chao Lee is the Director of Economic Research Department, Council for Economic Planning and Development, Executive Yaun, 87 Nanking E. Road, Sector 2, Taipai. Excerpts from a paper presented at the Asian Productivity Organisation (Tokyo); Top Forum for Policy/Decision Makers on Role of Govt. Policies in Productivity Improvement in Asian Region, held in New Delhi (Nov. 2-5, 1993).

The successful economic development of the Republic of China (Taiwan) during the past four decades has been widely held as a miracle. Apart from the hard work on the part of the Taiwanese people, the government has played an important role in transforming Taiwan from an undeveloped backward country into a highly developed newly industrialized economy (NIE) with the GNP per capita rising from just 196 US dollars in 1952 to 10,202 US dollars in 1992. Since all policies contribute to economic growth or productivity directly and indirectly, it is difficult to cite exactly the impact of different government policies on economic development. This paper presents an introduction to government policies in Taiwan and their impact on economic development and productivity. Firstly, the general characteristics of Taiwan's economic development have been set out. Secondly, the impacts of the policies or strategies adopted by the government in different phases of Taiwan's economic transition have been explained. Thirdly, policies which have been most effective in enhancing productivity are highlighted. Lastly, challenges to and prospects for Taiwan economy have been discussed, with particular reference to the current six-year National Development Plan and also the new Economic Revitalization Programme.

The government has played an important role in transforming Taiwan from an undeveloped backward country into a highly developed newly industrialized economy.

Characteristics of Taiwan's Economic Development

Taiwan's economy, over the past four decades, has been characterized by rapid economic growth, significant changes in the industrial structure, price stability, full employment, and equitable income distribution.

Economic Growth

From the fifties to the eighties, the average annual growth rate of the economy during each decade has been consistently above 8%, which compares favourably with those in other industrialized countries. Even when the economy was under threat from the global energy crises in the 1970s, Taiwan's average annual growth rate was as high as 10.2%. The annual real GNP per capita increased from 22 thousand NT dollars in the 1950s to 209 thousand NT dollars in the last three years. This amounts to a real GNP per capita growth rate during the four decades exceeding 4.5% per annum. It is expected that the growth rate of the economy will be at least 6% an year during the coming 5 years. This order of a continuing increase in real GNP per capita is likely to elevate Taiwan to the status of one of the wealthiest nations in the world. (table 1).

Table 1 Main Economic Indicators of R.O.C

	1951-59	1960-69	1970-79	1980-89	1990-92
Real GNP growth rate (%)	8.2[1]	9.1	10.2	8.2	6.1
Nominal GNP Per Capita (US$)	166	222	986	4007	8981
Real GNP Per Capita amount (NT$)	21759	34756	72076	136924	208843
growth rate (%)	4.6[2]	6.4	7.6	7.0	5.0
Consumer Prices					
gorwth rate (%)	—	4.8	8.9	4.4	4.1
Wholesale Prices					
growth rate (%)	8.0[3]	3.0	8.2	1.5	−1.2
Unemployment Rate (%)	4.0	3.3	1.7	2.1	1.6
Labor Force Participation Rate (%)	64.5	59.2	58.2	59.4	59.2

1. 1952-59, 2. 1962-69, 3. 1953-59

Source: 1. Directorate-General of Budget, Accounting and Statistics, *National Income*
2. Directorate-General of Budget, Accounting and Statistics, *Yearbook of Manpower Statistics*

A continuing increase in real GNP per capita is likely to elevate Taiwan to the status of one of the wealthiest nations in the world.

Changes in the Industrial Structure

Parallel to faster economic development, Taiwan's industrial structure has also been steadily improved and upgraded. In the earlier phase of Taiwan's economic development, agriculture has been the dominating sector of the economy, employing about, 56.1% of the country's labour force and accounting for about 32.2% of its Gross Domestic Product (GDP). Later, under the government's strategy of "developing agriculture by means of industry and fostering industry by using agriculture", both he sectors grew rapidly. In 1962, the value of industrial production surpassed that of agriculture; thus, industry began to play the leading role in Taiwan's economic development. At the end of the eighties, industrial growth slowed down, giving way to services sector in terms of output. Economic theory postulates that industry and services grow at the expense of agriculture. Only 3.5% of GDP was accounted for by agriculture in 1992, 14.4% by industry, and as high as 55.1% by services . As the pace of industrialization accelerated,- the industrial structure shifted away from labour-intensive light industries to capital-intensive heavy and chemical industries, and then to knowledge-intensive high-tech industries. (tables 2-3).

Table 2 Changes in Production Structure

	GDP at current prices	Agriculture	Industry	Services
1952	100.0	32.2	19.7	48.1
1962	100.0	25.0	28.2	46.8
1972	100.0	12.2	41.6	46.1
1982	100.0	7.7	44.4	47.9
1992	100.0	3.5	41.4	55.1

Source: Directorate-General of Budget, Accounting and Statistics, *National Income*

Table 3 Changes in Employment Structure (%)

	Total	Agriculture	Industry	Services
1952	100.0	56.1	16.9	27.0
1962	100.0	49.7	21.0	29.3
1972	100.0	33.0	31.8	35.2
1982	100.0	18.9	41.2	39.9
1992	100.0	12.3	39.6	48.1

Source: Directorate-General of Budget, Accounting and Statistics, *Year Book of Manpower Statistics*

The industrial structure shifted away from labour-intensive light industries to capital-intensive heavy and chemical industries, and then to knowledge-intensive high-tech industries.

Taiwan has not neglected the objective of achieving an even distribution of wealth among its people.

General Policies & their Impact

The success of Taiwan's economic development can be attributed to many factors. Among them, the implementation of a series of 9 economic development programmes and the adoption of the optimum sequence of development strategies by the government of the Republic of China, have undoubtedly played an important part in accelerating the onward movement. The following are some principal strategies or policies adopted by the government in different phases of Taiwan's economic transition (further details in Appendix).

Import Substitution Phase (1953-60)

During the early stage of its development, Taiwan, like other developing countries, suffered the distressing consequences of consistent trade deficits, high unemployment, and high inflation. In the 1950s, the government adopted a strategy of import substitution. With a series of protectionist measures, domestic labour-intensive industries were developed to help conserve foreign exchange and provide additional job opportunities. In 1953, the government started implementing the first of its series of four-year (or six-year) economic development plans. Land reform redistributed productive factors and increased the incentive of farmers to work, thus stimulating agricultural production. There was emphasis on agriculture to raise agricultural productivity and exports, as well as rural living standards. During this period, due to the success of the import substitution strategy, both agricultural and industrial production increased rapidly, The nominal growth rates being 13.7% and 22.5% respectively. The export growth rate reached 8.9%. Agricultural products and processed agricultural products were the main exports, accounting for as much as 86.2%.

Land reform redistributed productive factors and increased the incentive of farmers to work, thus stimulating agricultural production.

Export-Orientation Phase (1961-72)

By late 1950s, the negative influence of protectionist measures and restrictions had become apparent. For example, protectionism encouraged some industries of less importance or without comparative advantage to develop rapidly, thus resulting in misallocation of resources. At the same time, with the continuing expansion of the import substitution industries, goods produced exceeded those consumed in the domestic market. In order to overcome the constraint of a small domestic market which had restricted the scope for further expansion of these industries, the government decided to change its basic development strategy from inward orientation to outward or export orientation, and to carry out a series of reform measures.

The government decided to change its basic development strategy from inward orientation to outward or export orientation.

In 1958, the "Foreign Exchange and Trade Reform", was announced, changing the strategy from restricting imports inactively to encouraging exports vigorously, through such devices as customs duty rebates on exports, and scrapping of the import foreign exchange quota system. A unitary exchange rate was adopted in 1960, the exchange rate of the NT dollar to the US dollar declining sharply from 24:1 in 1958 to 40:1 in 1960. The government announced and implemented the "Nineteen-Point Economic and Fiscal Reform" in 1960, removing all unnecessary controls and establishing the capital market.

At the turn of 1960s, the "Statute for the Encouragement of Investment" was enacted to attract foreign as well as domestic capital to key industries. In 1966, Export Processing Zones were established. Export-oriented industries, designed to take advantage of low-cost labour, began to move gradually into world markets. In the agricultural sector, new farm products were developed, and the export of such products was vigorously promoted. As a result of these strategies, exports increased rapidly, reaching a growth rate of 20.4% per annum. Industrial products as a percentage of all exports rose from 13.8% in the import substitutional phase to 51.2% in 1960s.

Second Import-Substitution phase : (1973-83)

In the 1970s, the economy entered a new stage of development. Two oil crises caused worldwide economic depression. Taiwan found itself confronted with stagflation. Structural transformation was affected on all sides by these adverse conditions. Ten Major Development Projects and Twelve New Development Projects were carried out from 1973 and 1978 respectively, to increase infrastructural investment and to eliminate transport bottlenecks. These projects also made up for the gap caused by reductions in exports and private investment. Government policy emphasized on the production and export of consumer durables, capital goods, and the processing of raw materials. Basic and heavy industries and intermediate goods industries were established. However, the agricultural sector continued to receive attention: the "Status of Agricultural Development" and the "Systems of Price Guarantees for Rice" came into effect in 1973 and 1974, as the government moved to intensify rural development and improve farm incomes. During this period, the average annual growth rate of GDP reached 10.2%; agricultural production increased at a rate of 4.3% per annum; the increase in industrial production being 15.3% per annum. Industrial products became the main export item, constituting 85% of the total exports.

Liberalization & Internationalization phase (1984-to date)

During 1980s. Taiwan enjoyed a huge surplus in its foreign trade. Major trading partners became increasingly concerned about the growing trade imbalance. Therefore, the government adopted measures to liberalize imports on a large scale in order to reduce this surplus. Controls over imports were removed and tariffs significantly decreased. All foreign exchange controls on current account transactions had been abolished, regulations over international capital movements were greatly relaxed. The NT dollar appreciated substantially. In order to maintain Taiwan's competitiveness in world markets, industrial restructuring has been vigorously promoted. Under the "Science and Technology Development Programme" formulated in 1980, the Institute for Information Industry and the Hsinchu Science-Based Industrial Park were set up. In the meantime, to provide the highly trained manpower needed for this restructuring, educational institutions had been emphasising on an even greater role of science and technology. In this phase, the average annual growth rate of the GDP was 7.6%, with both exports and imports increasing by 10.1% per annum. Compared with the 1970s, growth of the economy during 1980s was relatively slow: nevertheless, compared with those in developed countries, Taiwan's performance was still very good.

Productivity-Related Policies & their Impact

Land Reforms

In 1949, the government decided to implernent a land reform programme to stimulate the development of the agricultural sector and to accelerate the transformation from an agricultural economy in to an industrial one. The land reform programme consisted of three parts: (1) A 37.5% rent reduction programme; a ceiling on the maximum amount of rent that landlords could regally charge their tenants. The programme offered a strong incentive for the farmers and eliminated possible exploitation by the landlords. (2) The government sold public land to the tenant cultivators, with the purchase price being payable by installments over ten years without any interest payment. (3) The land-to-the-tiller program, under which the government regulated the size of land that a landlord could retain, they being obliged to sell their excess land to the government. These landlords were then compensated with commodity bonds and public enterprise stocks instead of cash. After the government obtained the land from the landlords, it was resold to the tenant farmers. The idea that "the farmer cultivates his own land" was thus fully realized.

Benefits from the land reform programme were multifold. On the one hand, the programme increased the incentives of farmers to work, thus enhancing productivity greatly. It is reported that agricultural productivity increased by 21.5% between 1950 and 1955, while at the same time farmer productivity increased by 13.2% (Tenghui Lee, 1985). By implementing this land reform programme, the government successfully channeled farm capital into industrialization and other purposes. The rapid development of small and medium-sized business, beginning from the 1950s, can be attributed largely to the land reform. Thus, the land reform was an important programme which not only increased agricultural productivity but also enhanced overall productivity by the redistribution of productive factors.

The land reform was an important programme which not only increased agricultural productivity but also enhanced overall productivity by the redistribution of productive factors.

Manpower Policies

Given Taiwan's limited natural resources, the development of the economy depends on its human resources. With high population density, the government tried hard to break loose from the Malthusian low income trap and effectively make use of the surplus labour at the same time. Birth control policy was introduced in the 1950s and the government has invested heavily in education at all levels to upgrade the overall quality of manpower. To meet the requirements of economic development, different measures were carried out at different stages. For example, in the early 1960s, when there was an excess supply of labour, vocational education was promoted. In 1968, compulsory education was extended from six years to nine years. Thereafter, the quality of labour improved tremendously. Taiwan's workers now easily accept and operate new technologies. In 1983, the "Programme for the Training & Recruiting of High-level Personnel" was introduced, to help foster the development of university and graduate-level manpower to meet the development needs of high-tech industries. Further during the 1960s, the "Six-Year Development Plan" and the "Economic Revitalization Programme" both emphasizing the importance of education and training of labour had also been commenced. All these measures improved the overall quality of labour, and thereby enhanced productivity. Organizations were also set up for the specific purpose of raising productivity, the most important among them being the China Productivity Center (CPC), established in 1955. Since one-fifth of the Center's annual budget comes from the government, its activities can always be coordinated with government policy, to some extent. Functions performed by the CPC include: management technology consulting services, labour-management relations enhancement programmes, industrial automation promotion services, training programmes, and publicity and publication activities. All these helped to enhance the efficiency and productivity of private enterprises.

Taiwan's workers now easily accept and operate new technologies.

Automation Programme

After 1973, the economy advanced to levels beyond the labour-surplus stage of development. Since then, unskilled labour has been almost fully utilized, and wages have been rising. With keen competition from newcomers, labour-intensive production ceased to be advantageous to the ROC, Under such circumstance, the government decided to implement a series of automation plans to enhance productivity and keep Taiwan competitive in the world market. In 1982, the government implemented its "Production Automation Programme" to help the automation of private enterprises. Automation in the textile industry rose from 29% of all machines in 1981 to 65% in 1987; while in the electronics industry, it increased from 27% to 49%. This rapid increase in automation gave a further boost to productivity. Since 1980, the government has implemented the Industrial Automation Programme to further expand automation to all industries. This programme can be divided into four subprogrammes: automation of manufacturing industry, automation of commerce, automation of construction industry, and automation of agricultural industry. In the case of automation of manufacturing industry, for example, the first five-year industrial automation programme is being carried out from 1990 to 1995. The measures adopted to encourage automation include: low interest loans and tax reduction for purchase of automatic machines; tax reduction on expenditures for R & D connected with automation; and tax reduction on training skilled labour to use automatic machines. As a result of automation, it is expected that annual labour productivity will increase from 76 thousand US dollars per worker in 1990 to 93 thousand US dollars per worker in 1995. The efficiency of production will be thus enhanced to greater heights.

Challenges & Prospects

Over the past four decades, Taiwan has experienced remarkable economic success and a spectacular rise in its standard of living. More recently, however, amidst rising prosperity and affluence, there ere signs of imbalances and dislocations, including traffic congestion, environmental pollution, rising crime rate, and lack of cultural and recreational facilities. At the same time, the slump in private investment and substantial outflow of capital caused problems for further economic growth. To sustain steady economic growth, we have to deal with several basic issues such as: inadequacy of public facilities; difficulties in acquisition and high prices of industrial land; bottlenecks in upgrading industrial technology; rising labour costs and insufficient manual labour; and difficulty in obtaining finances. Recognizing these problems, much more efficient government management and careful planning are called for.

Six-Year Development Plan under implementation since 1991, was devised to rebuild economic and social

order, The Plan embodies four specific policy goals: to raise national income; to strengthen the infrastructure; to narrow the gap between urban and rural areas; and to improve the quality of life. The nation's industrial development will emphasize low energy consumption, high technology, high value-added, and low environmental impact. In order to enhance productivity and upgrade industry, emphasis is placed on technological advancement. Tax exemptions on the R & D expenditures of business, and direct government subsidies to some particular businesses, are recommended. To improve the quality of the labour force, vocational education and its coordination with industries are also emphasized in the Plan. Automation for production and management, and standardization, are encouraged by tax reduction and low-interest loans.

Economic Revitalization Programme to complement the Six-Year Development Plan, which increases public investment, has been brought into effect in July 1993 as a means to promote private investment. It contains two basic policy goals; (1) the acceleration of industrial upgradation, and (2) the development of Taiwan into an Asia-Pacific Regional Operations Centre. The programme again lays stress on the importance of enhancing productivity. To increase the supply of technical manpower, it emphasizes the strengthening of education and training at home, and recruitment from abroad. The government also vigorously encourages research and development in the private sector, offers attractive incentives for high-tech industries, facilitates the transfer of government-developed technology to private enterprises, uses government procurement as a means of promoting the development of private high-tech industries, and channels more of the Executive Yuan's Development Fund into high-tech investments.

The people of the Republic of China have overcome many difficulties by hard work and appropriate development strategies in the past four decades. In the challenging 1990s, quick responses to new problems and prompt adjustments to new circumstances are required to develop the country further. If the Six-Year Development Plan and Economic Revitalization Program are implemented successfully, we can expect not only to enhance productivity but also to ensure the emergence of Taiwan as an Asia-Pacific Regional Operations Centres.

References

CEPD, The Six-Year National Development Plan for Taiwan, Republic of China (1991-1996) — Macroeconomic Development Targets, 1991.

CEPD, Economic Revitalization Program — An Action Plan for the Promotion of Private Investment, July 1993.

Lee, Kao-Chao "The R.O.C. Economy: Development Experience and Policy", CEPD, 1992.

Li, K.T. "Policy Matrix for the Taiwan Economy", April 1989.

Li, K.T. "The Quest for Modernization: The Development Experience of The Republic of China on Taiwan", Reference Papers on Economic Development and Prospects of the Republic of China, compiled by Board of Foreign Trade, Ministry of Economic Affairs, Republic of China, Dec. 1992.

Chiang, P.K. "Past Experience and Future Prospects of The Economy in Taiwan, Republic of China", Reference Papers on Economic Development and Prospects of the Republic of China, compiled by Board of Foreign Trade, Ministry of Economic Affairs, Republic of China, Dec. 1992.

Hsieh, Samuel C. "ROC's Development Experience and its Relevance to Overseas Development Assistance", Reference Papers on Economic Development and Prospects of the Republic of China, compiled by Board of Foreign Trade, Ministry of Economic Affairs, Republic of China, Dec. 1992.

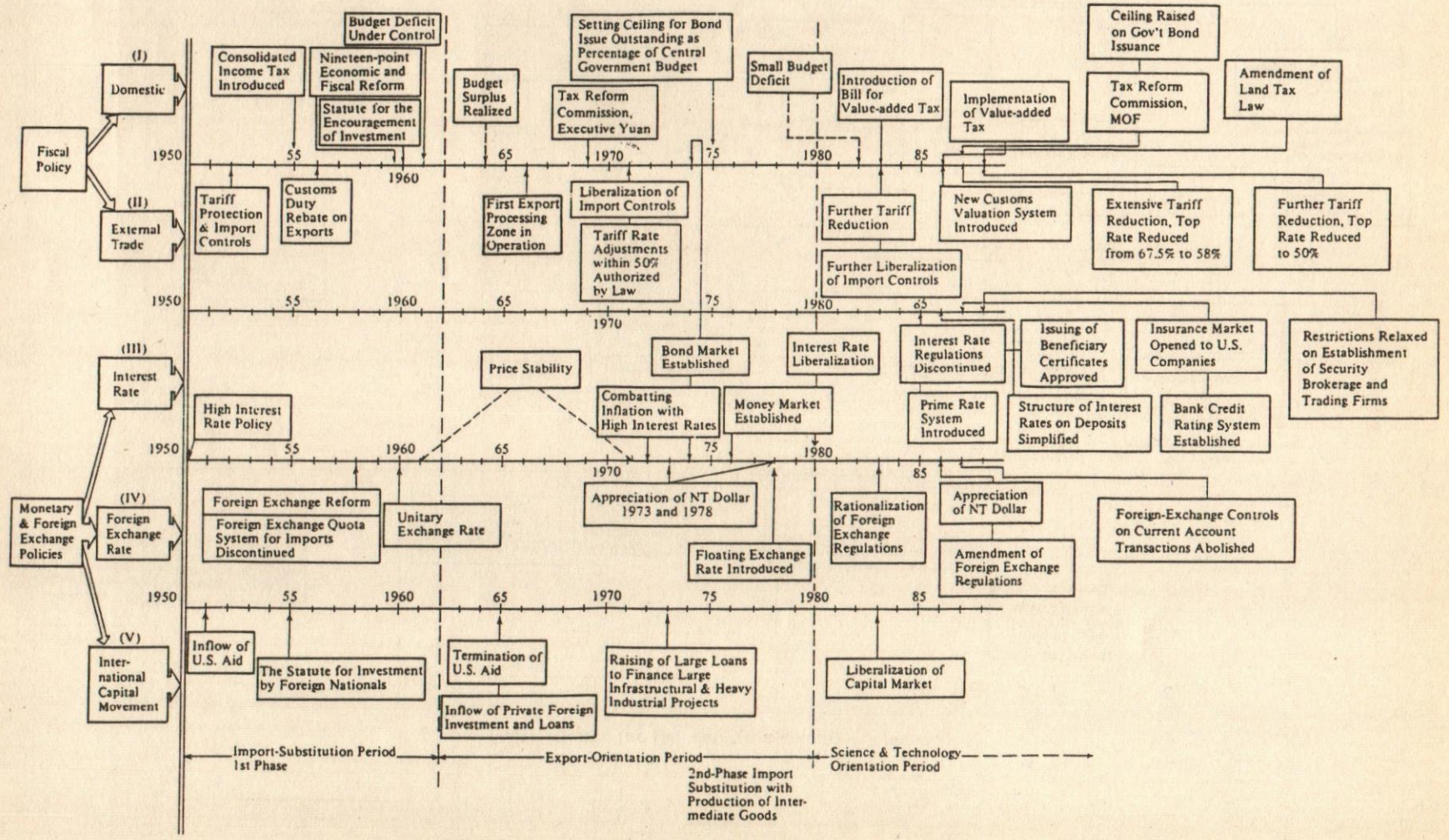
Gee, San "The Economic Development of Taiwan, R.O.C.: Experience and Challenges", Reference Papers on Economic Development and Prospects of the Republic of China, compiled by Board of Foreign Trade, Ministry of Economic Affairs, Republic of China, Dec. 1992.

Kuo, Shirley W.Y. "The Taiwan Economy in the 1990s", Reference Papers on Economic Development and Prospects of the Republic of China, compiled by Board of Foreign Trade, Ministry of Economic Affairs, Republic of China, Dec. 1992.

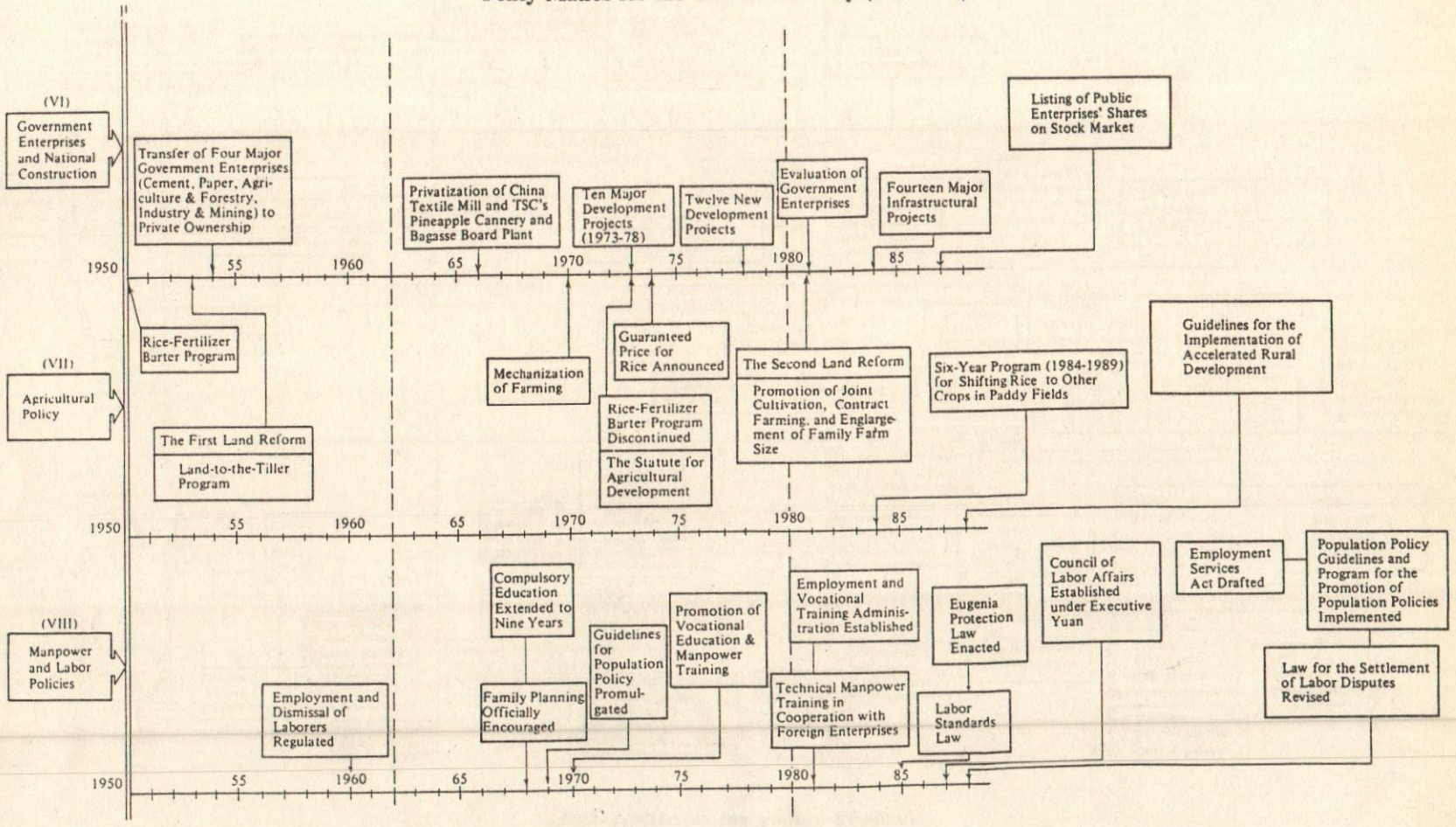
Yu, Tzong-shian "Achievement of Taiwan's Economic Development — A Miracle?", Reference Papers on Economic Development and Prospects of the Republic of China, compiled by Board of Foreign Trade, Ministry of Economic Affairs, Republic of China, Dec. 1992. □

Appendix

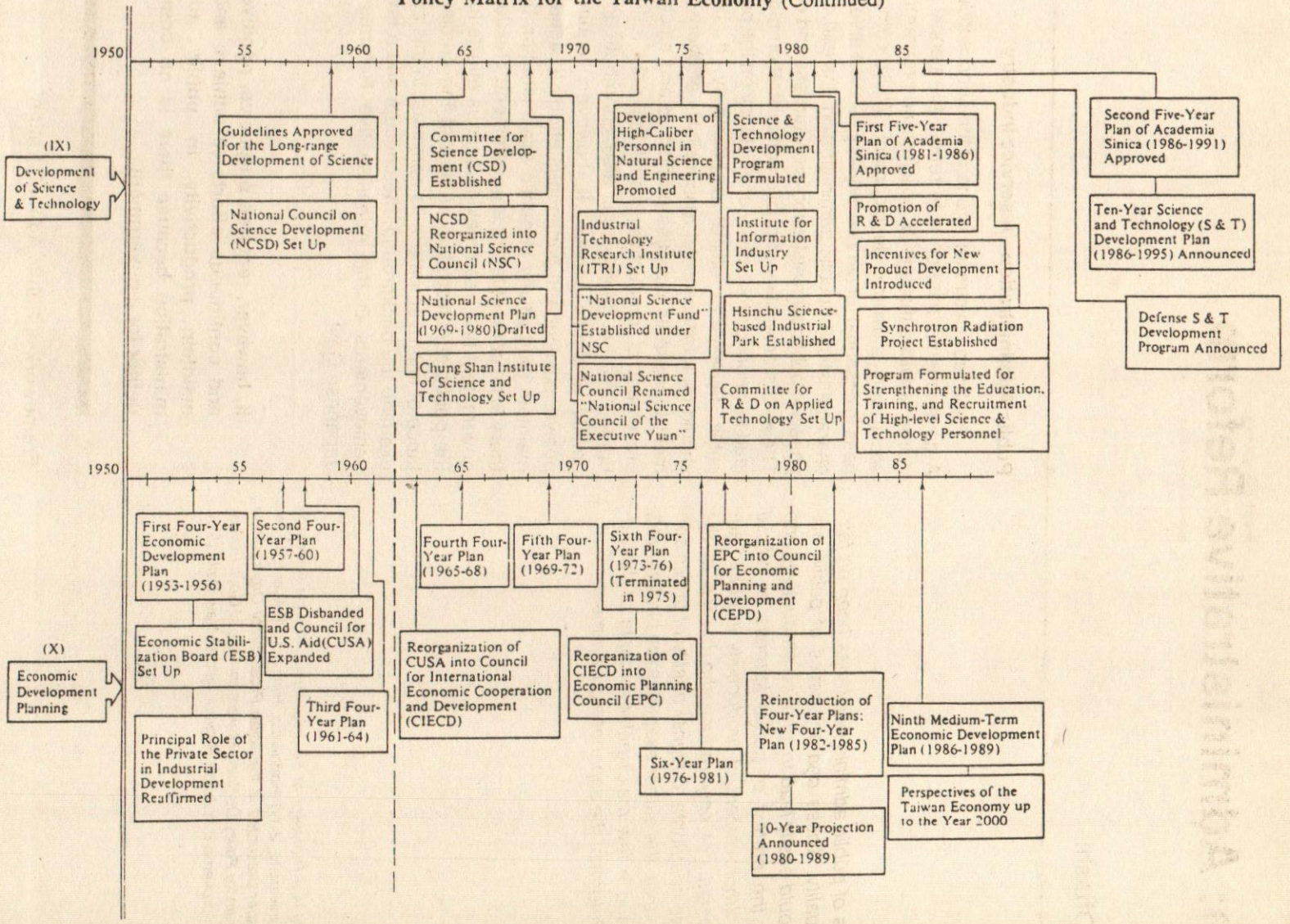
Policy Matrix for the Taiwan Economy



Policy Matrix for the Taiwan Economy (Continued)



Policy Matrix for the Taiwan Economy (Continued)



Source: K. T. Li, "Policy Matrix for the Taiwan Economy", April 1989.

Special Report

Japan: Administrative Reform

Tomohiro Ohashi

The emphasis of public administration has been on fairness and equality. These characteristics of public administration could easily lead to ignoring productivity and efficiency on the pretext of public fairness or official responsibility. Improvement of productivity in public administration could not only reduce the burden of the people but also contribute to higher quality of public services. In this paper, the author examines the background, the concept and a few major achievements of the Administrative Reform of the Japanese government.

Tomohiro Ohashi is a Professor at the Information Service Research Centre, Meisei University, 2-1-1 Hodokubo, Hino-sity, Tokyo 191, Excerpts from a paper presented at the Asian Productivity Organisation (Tokyo), Top Forum for Policy/Decision Makers on Role of Govt. Polices in Productivity Improvement in Asian Region, held in New Delhi (Nov. 2-5, 1993).

Public Administration : A service Industry

Public administration is one of the service industries. A government's mission is to render the people the required services through its policies and programmes for social and economic development. While competitiveness is essential for service industry, it is not an essential characteristics of public administration. Instead, the emphasis in public administration is on fairness and equality. These characteristics of public administration may often lead to ignoring productivity or efficiency on the pretext of public fairness or official responsibility. It, however, should be a fundamental responsibility of every government to make its activities productive and efficient. Improvement of productivity could not only reduce the burden of the people, but also contribute to better quality of public service. It, however, requires purposive, positive and continuous efforts to achieve and maintain productivity in public administration because there is no competitor for a government. The Japanese government has been making serious efforts to reform the public administration in view of the crucial importance of improvements in its activities. In this paper we examine the background, the concept and a few major achievements of the Administrative Reforms of the Japanese Govt.

It, however, requires purposive, positive and continuous efforts to achieve and maintain productivity in public administration because there is no competitor for a government.

Framework of Public Administration

Authorities of the Japanese government are divided among three branches as shown in figure 1. These three branches are fully independent. The organizational struc-

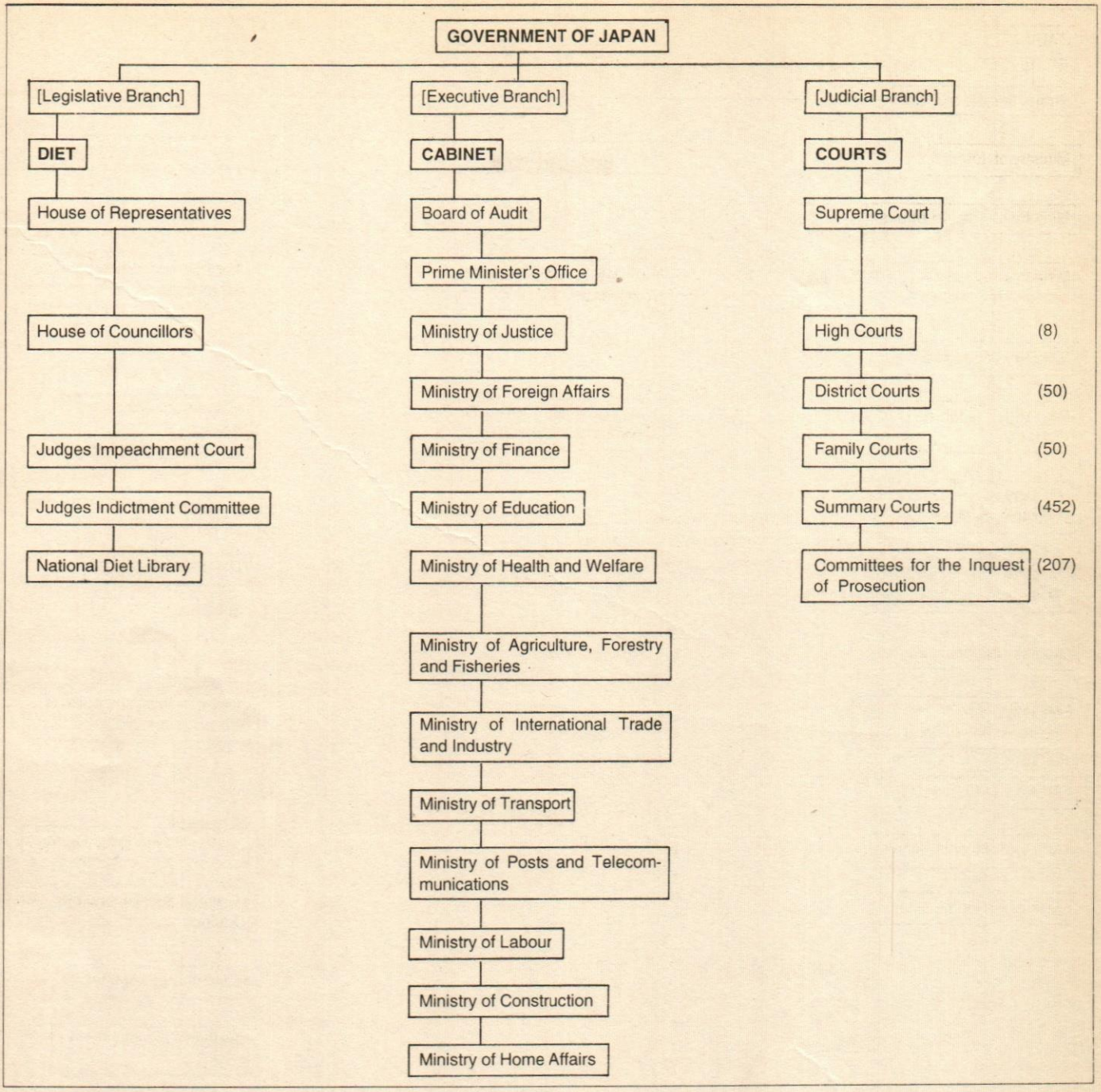


Fig. 1. Framework of the Government

ture of the government is rather similar to those in other countries; but an important distinction is in regard to the functioning of nine agencies which are under the Prime Minister's Office (figure 2). While these agencies coordinate relevant fields, the functions of the twelve ministries are substantive. The maximum number of ministers is fixed at less than twenty by the Cabinet Law. It means that most of the agencies have their own ministers and, therefore, they are not directly reporting to the prime minister. The typical organizational structure of ministries is shown in figure 3.

Managerial Functions of Public Administration

Functions of public administration are shared by the Ministry of finance and the Management and Coordina-

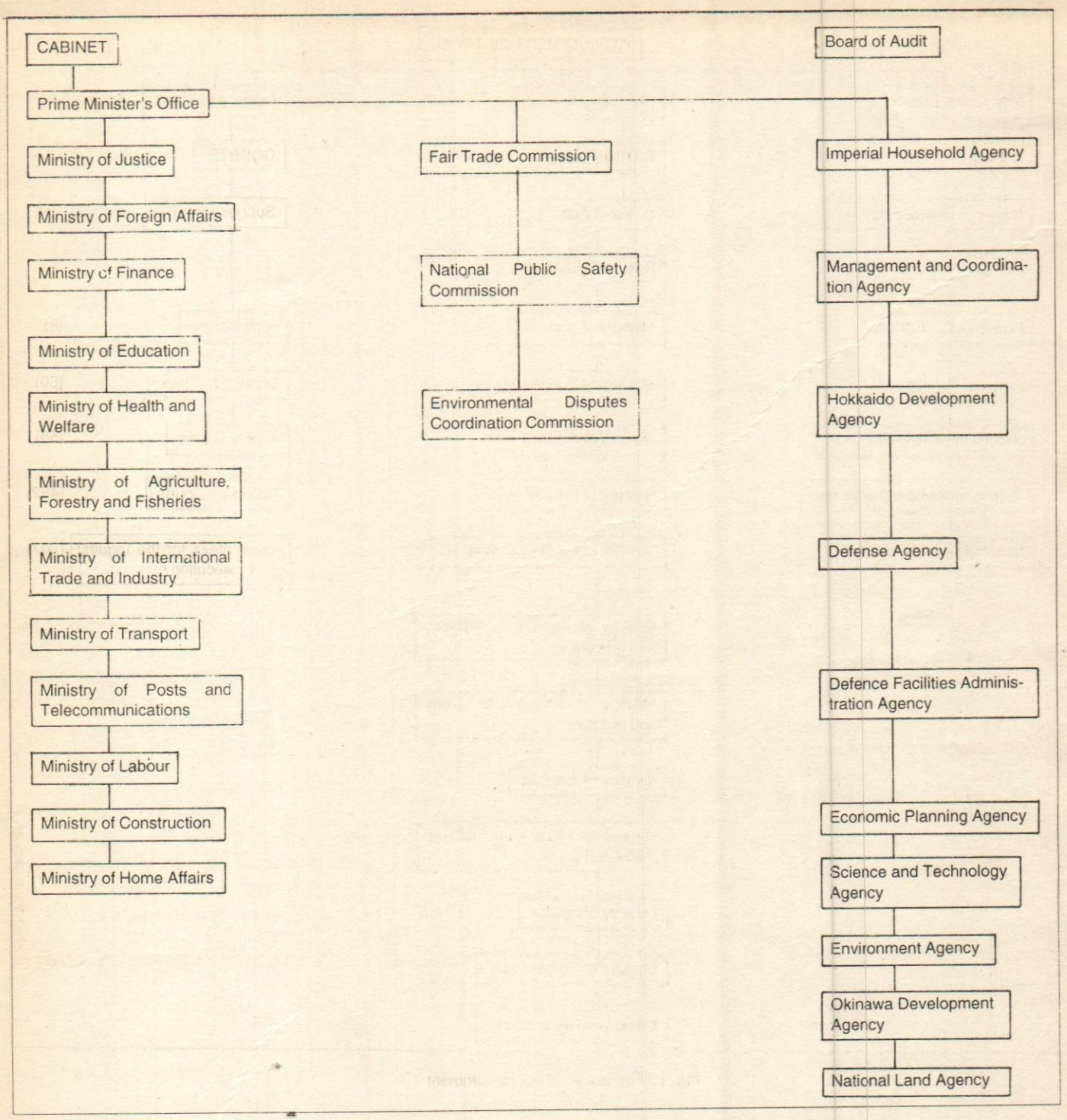


Fig. 2. Frame Work of the Government

tion Agency. While the former is responsible for coordination of policies and activities of the ministries through budgeting, the latter is responsible for general public administration such as the organizational structure and the number of civil servants. Functions of the Administrative Management Bureau of the Management and Coordination Agency are prescribed in the National Government Organization Law (fig. 4). In addition to these functions, the Agency has also been responsible for the promotion of the administrative reform in the past ten years, and has been the secretariat of the Provisional Commission on Administrative Reform. (PCAR)

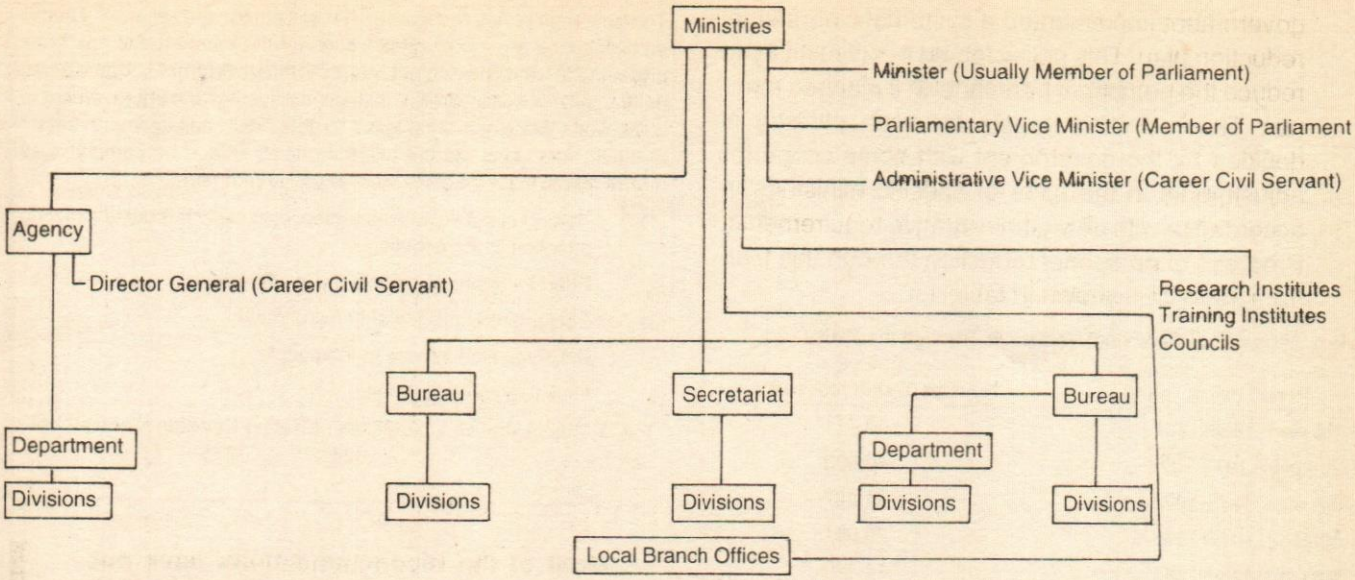


Fig. 3. Typical Internal Structure of the Ministries

(1)	Planning of fundamental matters concerning the administrative systems in general.
(2)	Coordinating and integration of the organizational structure, fixed number of personnel and the management of administrative organs.
(3)	Survey, planning and development of programmes and making recommendations concerning the organisational structure, fixed number of personnel and the management of administrative organs.
(4)	Review of establishment, alteration and abolition of administrative organs as well as their fixed number of personnel.
(5)	Review of establishment or abolition of public corporations, and also alteration of objectives and modification of other systems provided for by law concerning public corporations.
(6)	Coordination and formulation of plans for the development and improvement of administrative information systems and the use of computers in government, including management of the Inter-Ministerial Computer Center;
(7)	Matters concerning implementation and enforcement of the Act for Protection of Computer Processes Personal Data held by Administrative Organs.

Fig. 4. Functions of the Management and Coordination Agency

Practice of Public Administration

In accordance with the functions prescribed under the National Government Law, the Management and coordination Agency has been carrying out management of public administration. The key concept behind the major policies and practices of public administration has been simplification for effectiveness, efficiency and adequacy.

Curtailment of Administrative Organisation

The government implemented a policy of "scrap-and-build" in the late 1960's in order to curtail the growth of administrative organs. This policy was applied to the public corporations, too. Creation of a new organizational unit must be compensated by the abolition of an equivalent unit under this policy. The aim of the policy is to force every ministry to review *the raison d'etre* of the existing organizations before they request for a new organization. The policy is not to fix the organizational structure; but is rather to contribute to the dynamic restructuring of organizations of the ministries to meet their new requirements.

The key concept behind the major policies and practices of public administration has been simplification for effectiveness, efficiency and adequacy.

Curtailment of Manpower

As in the case of the administrative organs, increase in the number of civil servants is strictly regulated. The manpower control mechanism is as follows:

(a) *Total Staff Number Law.*
A Law on the Fixed Number of Personnel of Administrative Organs (the so-called Total Staff Number Law) was enacted in 1967. The Law stipulates the upper limit of the total number of full-time permanent personnel to 899, 333.

(b) *Personnel Reduction Plan*
In addition to the upper limit of the total number,

government implemented a systematic personnel reduction plan. This policy forced every ministry to reduce the number of personnel in a planned manner. The reduction targets for each ministry is decided by the government with some scope for adjustments in the case of specific ministries in accordance with new administrative requirements. Progress of personnel reduction through this plan from 1968 till is shown in table 1.

Table 1 Progress of Personnel Reduction Through the Plan

Period (fiscal years)	Number of staff reduced
1st plan: 1968-1971	43,711
2nd plan: 1972-1974	43,088
3rd plan: 1975-1976	21,527
4th plan: 1977-1979	20,081
5th plan: 1980-1981	14,890
6th plan: 1982-1986	49,934
7th plan: 1987-1991	48,901
Total	242,132

(c) *Annual Staff Number Review*

Parallel with the reduction of personnel through the Plan, every ministry has an opportunity to increase the number of staff every year. The requests for the increase in staff to meet important requirements are submitted to the Management and Co-ordination Agency every year. Nevertheless, the size of increase for each ministry is quite small and the total number of government personnel has been controlled so that it is finally within the upper limit prescribed by the law. Thus, while the number of the personnel is controlled through the Reduction Plan, some increase is permitted based on the annual request. This is the "scrap and-build" approach of the government for its personnel.

Administrative Reform : Background and History

The Administrative Reform has a long history in Japan starting from November 1945. just three months after the end of World War II. Initially, the reform measures concentrated on basic issues such as improvement of services to the people and efficiency of office work. The aims of these administrative reform measures were decided in the cabinet meetings as given in fig. 5.

The final report on the First Administrative Reform, started late 1950s. was submitted by the First Provisional Commission on Administrative Reform. Nevertheless, most of the recommendations have not been accomplished, because they were perfect and excellent but not practical and were difficult to implement.

The government has recognized that settlement and renewal of public administration are most urgent issues for the moment and has been preparing for and carrying out reform of the government organization, modification of administrative institutional system and improvement of office work. While achieving these targets, "activities for improvement of office work" such as the following items should be completed to reform and to improve office work in the government :

(1) Reform of public administration, especially through promoting attention to the people

(2) Effort for improving efficiency of office work

(3) Settlement of office work environment

(4) Providing kind service to the people

(5) Finishing pending issues.

Fig. 5 Administrative Vice-Minister Meeting Decision in November 1945

Most of the recommendations have not been accomplished, because they were perfect and excellent but not practical and were difficult to implement.

During the 1970s Japan faced economic difficulties caused by the "oil crises". Japan also seriously suffered from the environmental pollution caused by the rapid industrial growth. The financial situation of the government worsened while solving these problems. Under these circumstances it was necessary for the government to review its policies and to establish a new concept and direction for Japan for the moment. Thus, the Second Provisional Commission on Administrative Reform (PCAR) was established in March 1981, which consisted of many civilian commissioners from business and academic fields. Tasks of the PCAR were to review public administration, to conduct research on fundamental issues and to compile recommendations to assist the government in restoring the financial situation and in responding to economic was completed in March 1983.

This report was quite different from the first one. It has identified basic stances and concrete measures to promote the Reform. Most of the recommendations were found to be practical. The activities based on the recommendations have been enforced by the cabinet decisions every year after 1984. A significant aspect of the Report is in respect of the availability of information technology to support the government in carrying out the Reform.

Decisions on policies and activities of a government became complex in recent years because of the rapid changes in social and economic situations; especially in

the international environment and relationships. These changes make the policies and activities of a government more diversified. Financial health is also a critical issue for a government. The recent economic recession, from which a rapid recovery has not been expected, could worsen the financial situation of the government. Cost-saving is, thus, an urgent issue for the government at the moment. These are the fundamental factors that have encouraged the Japanese government to promote the Administrative Reform in these ten years.

Financial health is also a critical issue for a government.

Major Purpose & Targets of the Reform

The major objective of the Reform is to restore the financial health of the government by reducing the expenditures thus avoiding any increase in taxes. In the final recommendations of the PCAR, two issues, "construction of the welfare society with vitality" and "positive contribution to international society", have been identified as the goals of the government for the moment. In addition, four basic targets for reviewing existing public administration and promoting the Reform have been advocated. (fig. 6). Major actions identified in order to achieve the two goals and the four basic targets are given in Fig. 7.

(i) Responding and adapting to economic and social changes

(ii) Keeping comprehensiveness and consistency of policies

(iii) Promoting efficiency improvements in governmental activities

(iv) Gaining credibility of the people to the government.

Fig. 6 Four Basic Targets

(i) Restructuring of the administrative organization

(ii) Reform of national enterprises and public corporations

(iii) Review of relationships between national and local governments

(iv) Review of subsidies

(v) Improvement of quality of public services to the people

(vi) Reform of institutional system and procedures of budgeting and accounting

(vii) Improvement of access to administrative records and information.

Fig. 7 Major Actions

Major Achievements of the Reform

(1) Restructuring of the Administrative Organs

The government has been curbing expansion in the organization of the ministries, and the so-called "scrap-and-build" principle has been maintained while creating a new organization. In addition to this policy, the PACAR advocated that the government organization should be simple, effective, efficient and flexible enough to meet changes in economic and social environment.

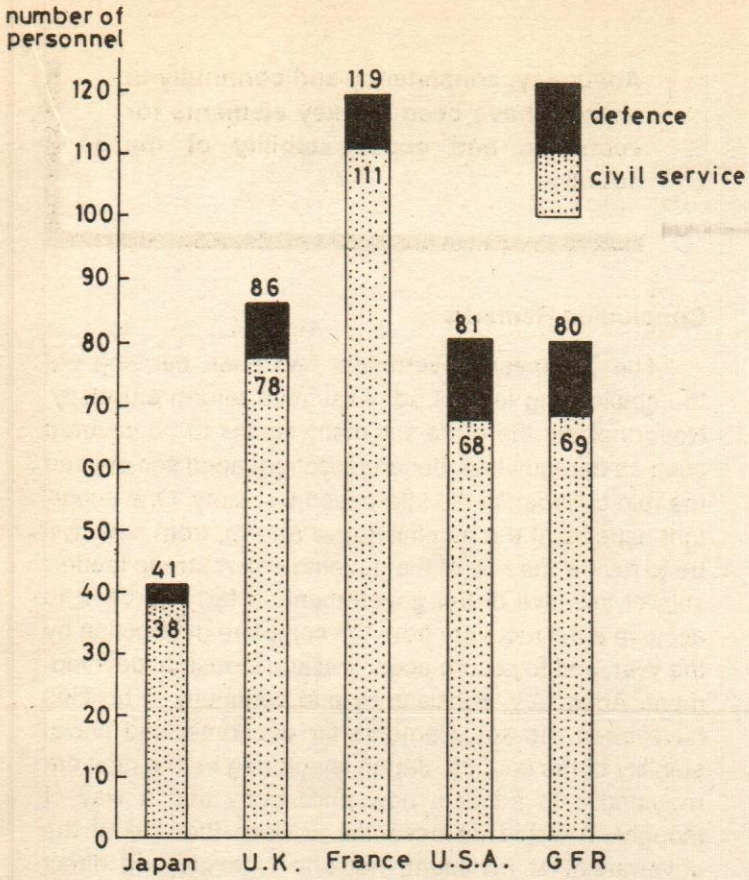
Increase in organization of the government has been minimum due to the "scrap-and-build" principle in spite of the newly established agencies (Environment Agency, National Agency & Okinawa Development Agency which were established to meet new requirements). In accordance with the recommendation the Management and coordination Agency has been newly built, integrating some existing bureaus and divisions of the Prime Minister's Office with the former Administrative Management Agency which was abolished in order to enhance coordination function of the cabinet.

Increase in organization of the government has been minimum due to the "scrap-and-build" principle.

Restructuring of the existing organization is another important approach of the Reform. In these seven years from 1984, just after the final report of the Committee, twenty-seven bureaus, (about 21% of the total 128 bureaus) have been restructured and their functions have been modified to meet the new administrative requirements without any increase in the number of bureaus. Fifty-four local branch offices at district level ere abolished from 1984 to 1988, and one hundred and seventy-eight offices at prefecture level, and eight hundred and nine offices at levels lower than the prefecture were also abolished.

Under the "scrap-and-build" principle number of bureaus is held same since 1979. One hundred and sixteen divisions at central level have been reduced while on hundred and twenty-four divisions were restructured in these years by the Reform. The number of reduced and restructured offices exceeded 10% of the total number of divisions, thus exceeding the target of the Reform (figure 8).

Under the "scrap-and-build" principle number of bureaus is held same since 1979.



Note: 1. The national and local civil servants and the staff of government corporations included in civil service work force.
2. The figures of 1988 in principle.

Fig. 10 International Comparison on Number of Civil Servants (Persons per 000 population)

In addition to the restructuring, a great achievement was in the area of privatization of the public corporations; privatization of Japanese National Railways (JR), Japan Tobacco and Salt Monopoly (JT) and Nippon Telegraph and Telephone Public Corporation (NTT). Impact of these privatization measures was significant in both economic and social fields because they were the big three public corporations with a long history of serving the people Major effects of these privatization measures are:

(i) Productivity improvement was so high that the staff requirements were reduced in these three public corporations by approximately one hundred and eighty thousand.

(ii) Capital gains by selling stocks of the NTT amounted to a straggering 1,082 billion yen which was utilized as social capital.

Institutional system for promoting the Reform

After getting the final report from the Provisional Committee for Administrative Reform (PCAR), the government established a council, the Provisional Council for Promotion of the Administrative Reform (PCPAR) to carry out the reforms recommenced by the PCAR. The PCPAR consists of professionals from various fields just the same way as the PCAR. Management and Coordinating Agency is responsible for carrying out the reforms as the secretariat of the PCPAR. At the moment administrative reform in Japan is being carried out by this system. In addition, the government has taken a decision at the cabinet level to identify at the end of every year major issues to be carried out in the next fiscal year in line with the Administrative Reform. The items of the cabinet decision in December 1992 (fig. 12) suggest what are still critical for Japanese.

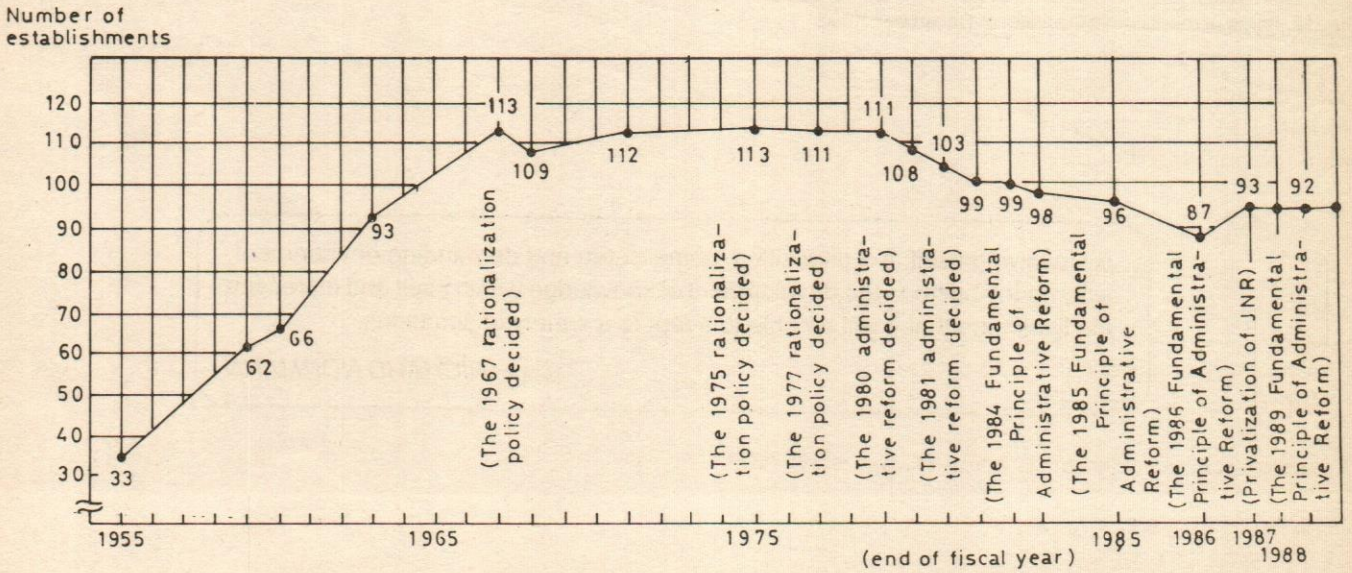


Fig. 11 Changes in Number of Public Corporations

(i) Administrative Organizations
  1. Restructuring of organizations of central level
  2. Restructuring of organizations of local level
(ii) Management of the number of Staff
  1. Reduction of the number of government staff
  2. Promotion of transferring staff among ministers
  3. Personnel management
(iii) Government Enterprises
  1. Postal services
  2. National forestry
  3. National hospitals
(iv) Public Corporations
  1. Reform of three big corporations
  2. Re-vitalization of public corporations
(v) De-regulation
(vi) Relationship between national and local governments
(vii) Important policies
  1. Foreign policies
  2. DDA
  3. Environment
  4. R&D of Science and Technology
  5. Health, medical services and welfare
  6. Education and culture
  7. Foreign workers
  8. Land administration
  9. Agriculture
  10. Security and finance
(viii) Common administrative procedures
  1. Administrative procedure systems
  2. Promotion of information systems
  3. Administrative appeal systems
  4. Improvement of public services

Fig. 12. Items of the Cabinet Decision in December, 1992.

Adequacy, consistency and continuity in policies have been the key elements for economic and social stability of the country.

Concluding Remarks

The Japanese government has been carrying out the challenging task of administrative reform earnestly. Nevertheless, there are still many issues to be covered such as deregulation, decentralization, aged society and the role of Japan in the international society. One important aspects of the administrative reform, from now, will be to review the role of the government. A strong leadership or initiative of the government so far, has been to achieve a full recovery from the complete destruction by the War, and to secure economic and industrial development. Adequacy, consistency and continuity in policies have been the key elements for economic and social stability of the country. Japan is entering in to a new era requiring it to adopt a new philosophy and a way of thought. It would be essential to keep the role of the government at minimum; not one of exercising direct control or regulation but more of rendering assistance or support and encouraging economic and social activities in the private sector. Thus, the next mission of administrative reform should be to identify and design a new vision and the corresponding strategic policies to meet these critical issues for the government and the people. □

By involving itself in a diversified, complicated and demanding environment, a company hastens the development of knowledge within itself and increases the likelihood that it will be able to adapt to a variety of situations.

RICHARD NORMANN

Dynamics of Major Projects: System Approach to Project Management

R.S. Gupta

Project management has grown into a well developed science over the last four decades. Yet, the track record of major projects is dismally poor. The project managers can be held partly responsible for unsatisfactory performance. There are, however, a large number of other factors contributing to overruns. The author draws attention to these non-traditional factors which influence project schedules and costs and suggests that they must be treated as a part of the total system of the project management.

R.S. Gupta is former Dy. Director General, National Productivity Council.

Project management is by now a relatively well developed management discipline. It was conceived in the 1950s, essentially in the defence and petrochemical industries. Project management was clearly identified as a separate discipline in the Atlas missile programme of 1954 and in the Polaris programme of 1955. It has since been developing steadily. Several professional societies have been established in Europe, USA, Australia, Japan and in India and degree courses are offered at several universities in USA and Europe.

Projects are undertaken to achieve specified objectives, defined usually in terms of technical performance, budget and time schedule. These are accomplished according to a common life cycle as shown in figures 1 and 2. Every project, no matter of what kind or for what duration, essentially follows the activity sequence of identification and definition, prefeasibility/feasibility, design and contract negotiation, implementation, commissioning, handover, in-service support and final evaluation. The life cycle of projects is relatively straight forward. The success or otherwise of the project, however, depends upon the skill of the project manager; his innate appreciation of the requirements of progressing the project through this life cycle. In doing so, many issues arise which are common to all kinds of projects, e.g., those of leadership and organisation, financing, planning and control, and contracting of third parties; while there are others which are peculiar and project specific.

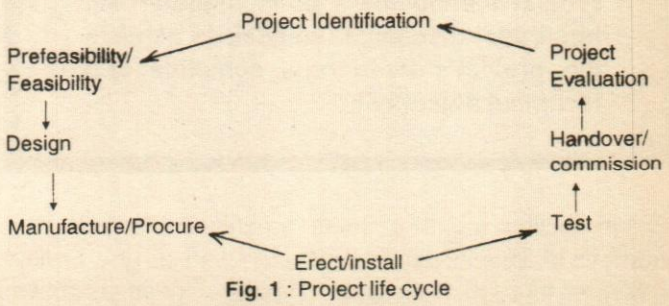


Fig. 1 : Project life cycle

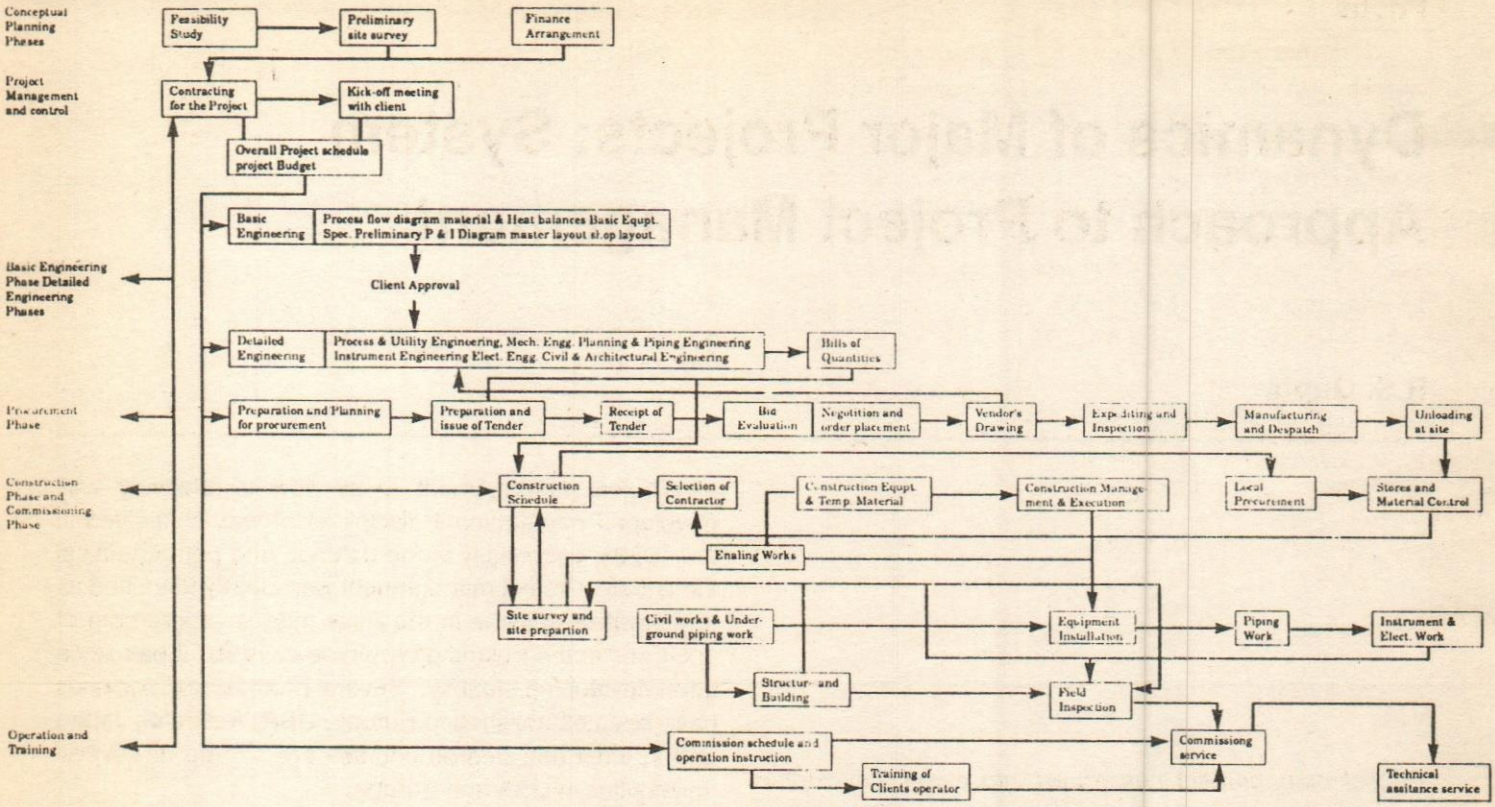


Fig. 2. Another view of Project Lifecycle.

Project Management

Project management pulls together the functional disciplines needed to achieve the project's budgetary, schedule and technical objectives. As Olsen (1971) defined it: "Project management is the application of a collection of tools and techniques (such as CPM and matrix organisation) to direct the use of diverse resources towards the accomplishment of a unique, complex, one-time task within time, cost and quality constraints. Each task requires a particular mix of these tools and techniques structured to fit the task environment and life-cycle (from conception to completion) of the task" (quoted in Saxena, 1991)

Project management pulls together the functional disciplines needed to achieve the project's budgetary, schedule and technical objectives.

In pulling together these functional disciplines, a number of special techniques are used as the project develops through its lifecycle. Typical of these, as shown in figure 3, are design management, scheduling, work breakdown analysis, task-responsibility matrices, performance measurement, project organisation, cost control, contract administration, quality management, team selection and building.

Despite the enormous attention project management has received over the years, the track record of projects whether abroad or in India, is fundamentally poor, particularly for the larger and difficult ones. Overruns are common—projects are often completed late or over budget. They do not perform the way they are expected. They cause severe strain on participating institutions or are cancelled prior to their completion after considerable sums of money have been spent. Thus most projects appear as failure in the public view. Many reports are available on the record of project overruns (Morris & Haugh, 1987) but there are hardly any showing underruns (less than one percent). In several industries all over the world, overruns are the norm varying between 40 to 1000 percent (Table 1). Why does the record consistently show project overruns to be a rule rather than exception? Is this an indictment on the project management? Or are there some other specific reasons? Incompetence of the project managers can not be altogether ruled out but it is almost certainly less sig-

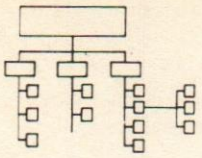
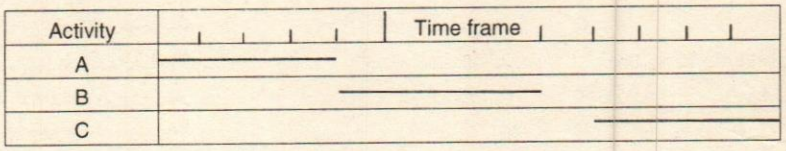
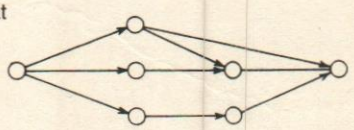
Table 1: Project Overrun Record

Study Title	Projects studied	Overrun	Principal reasons
Harman, 1970	25 US weapon system projects	50-700% cost increase	Project size, complexity, technological advance and development strategy
Myers and Devey, 1984	55 US process plants (33 having pioneer technology)	140-210% cost increase 0-30 months schedule increase	Cost: technological innovation and poor project definition, Schedule: concurrency
Blake et al: 1976	Various US power plants	58-258% cost overrun	
Merewitz, 1973	49 US highway projects	– 40% to + 80% cost overrun – 30% to + 110% cost overrun – 20% to + 145% cost overrun – 20% to + 250% cost overrun	
Utility Data Institute, 1985	42 US nuclear plants	190-3,900% cost overrun	
World Bank, 1985	1,014 World Bank projects	30-40% cost overrun	Inflation, especially 1979-80, delays due to increased innovation and complexity; an institutional capability in host countries which did not keep pace with this; and changes.
Healey, 1964	13 Indian irrigation and power projects	12-230% cost increase	Design changes; escalation; increase in scope; mis-estimation.
Ministry of Programme Implementation	187 Indian public sector projects	19 to 45% cost increase 0-19% schedule overrun	Late approvals; site acquisition and clearing equipment supply; slow performance; scope and design changes; estimating uncertainties; increased interest charges; funding availability
Institute of Industrial Economics, 1970	20 oil projects	10-780% cost overrun	
National Economic Development Office, 1970	13 UK power projects, 16 UK oil and chemical plants, 7 UK oil gasification projects	0-50% cost increases 0-27 month (35%) schedule increase	Inappropriate contract policies; late design information; insufficient training; poor industrial relations management.
Wilson, 1969	36 CEGB power plants	43% of units have 12 months schedule overrun	Adverse site conditions; manufacturing difficulties design faults; labour problems.

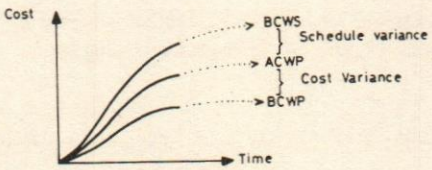
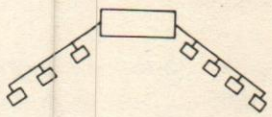
nificant than normally thought. The frequency of overruns across so many different industries, quoted in table 1, suggests that the reasons for the overruns are generally to be found in areas which have traditionally not been the concern of project management. If we are to manage our projects better, we must learn to manage these "other" factors more effectively. These include escalation, government or client induced changes, increased order quantities including spares, increased safety requirements, interest charges, land acquisition charges and so on. Indeed, many projects overrun because of circumstances 'external' to the project like price escalation, government action, strikes, corporate decisions, or acts of God. Interestingly, for the project sponsor— its owner or his financier - overruns are not necessarily even the best measure of project success. The project may still be profitable with cost and time overruns. Vice versa could also be true. Internal rate of return may well be a more appropriate measure of success for the project sponsor (Roundinelli, 1977).

Many projects overrun because of circumstances 'external' to the project like price escalation, government action strikes, corporate decisions, or acts of God.

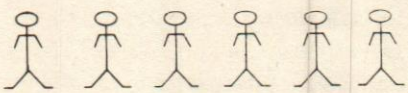
Some projects are so large or complex or difficult that they require an exceptionally skilled management. Major projects are particularly demanding either because of their size, complexity, schedule urgency or excessive

Specification	A traditional engineering tool necessary for establishing the project base line.
Work breakdown structure (WBS)	
Configuration Management	The technique of defining and monitoring the project engineering configuration and ensuring that all parties are using the same up-to-date configuration information.
Bar Chart	
Network Scheduling	Indicates : Sequencing of activities; longest path; float 
Task responsibility matrix	

ORG		Tasks		
		1	2	3
RESP	R_1	S	E	C
	R_2	E	C	S
	R_3	C	S	E

Performance Measurement	 BCWS : Budgeted cost of work schedule ACWP : Actual cost of work performed BCWP : Budgeted cost of work performed
Matrix organisation	Three kinds of organisation found in projects — a) functional b) project c) matrix 
Cost control	COST

ACTIVITY	Budgeted	Actual	Variance

Contract Administration	At the contract management level, the skill of negotiating and administering the contracts
Quality Assurance	Documenting quality standards and inspection procedures and ensuring that procurement and execution adhere to the presented schedule.
Team Building	

Source : Modified from Morris Haugh (1987)

Fig. 3 : Commonly User Project Management Techniques

demand on limited resources or know-how. The project does not become complex or large purely in monetary terms but also when it exceeds our know how or it poses special problem of urgency, coordination levels or other forms of major difficulties. Most of the projects which our society embarks upon are in effect major ones. Society does not grow in small increments— the development of the railways the building of major road systems, the construction of the electricity system, the development of airports and harbours, the installation of telecommunication networks, and development of major new products, the gradual exploration and development of space, the implementation of major health, education and welfare programmes are all examples of major projects which have been and continue to be central to the development of our society. Yet too often we manage such important developmental projects poorly. Given the frequently poor record of major projects, the management has to respond more vigorously and aggressively, using all the skills and experience at its disposal to reverse the trend. In the present economic scenario,-major projects are the order of the day both in industry and government-Majority of today's defence projects are inescapably expensive and complex, the petroleum, gas and petrochemical industries are predominantly major ones. Such projects - be it a space station, a telecommunications link, a reaf-forestation programme for the desert, or a major infrastructure development such as a tunnel, a bridge, or a waste water/scheme obviously make a major contribution to the society.

Factors of Success/Failure

Though the failure rate for major projects is high, no one can advocate scrapping the projects because of their tremendous impact on the socio-economic development of the society. What is really important is to analyse the factors leading to project failures and learn from them. First, "Success" and "Failure" need to be precisely defined. As already mentioned, cost and time overruns are not viewed very seriously by the sponsor as long as the project renders adequate internal rate of return. But this is a very narrow view of "success". Morris & Hough (1987) have identified 3 major perspectives for determining the success (or failure) of a project:

Project functionality: Does the project perform financially, technically or otherwise in the way expected by the project's sponsor?

Project management: Was the project implemented to budget, on schedule, to technical specification?

Contractors' commercial performance: Did those who provided a service for the project benefit commercially? Based on the reports of the Ministry of Programme Implementation, Government of India, World Bank reports and analysis of the 9 case studies by Morris & Haugh, (1987) factors leading to the success (or failure) of the projects in relation to the three dimensions referred, can be identified.

Only those projects whose objectives are clear, precise and allow a simpler and immediate evaluation tend to succeed.

Project Functionality

The analysis of the various reports from a *functionality* viewpoint suggests that only those projects whose objectives are clear, precise and allow a simpler and immediate evaluation tend to succeed. Projects having vague and complex objectives requiring lengthy analysis are, by and large, doomed to failure from the very beginning. However, large and complex projects pose inherent challenges. For example, some projects are launched with clear objectives but with considerable uncertainty whether they would be technically achievable. This is particularly true with major irrigation and hydel projects. Sometimes technical changes become inevitable because objectives get changed with passage of time, as in the case of defence projects and natural resource based projects. Over the years, projects perception has also broadened. Projects are no more concerned only with commercial, technical, organisational and financial aspects, but they need to attend to broader social, community, political, environmental, scarce natural resource usage, and other aspects affecting and affected by them. In larger projects, there are more than one participant and the project goals can not be arrived at without consensus. Examples are social projects or projects requiring inter-state participation. Thus it is not enough to identify, investigate and communicate the project objectives. They must be evolved through a system approach, enumerating precisely primary and secondary objectives. They must provide strong motivation to all the participating agencies. Above all, there has to be a strong leadership which should provide both the will and strong direction for the project to go ahead. The analysis of project management dimension brings out several factors of success and failures:

It is not enough to identify, investigate and communicate the project objectives. They must be evolved through a system approach.

Design aspect

Time and cost overruns are inevitable in those projects which suffer from technical uncertainty. Use of established designs and technology makes projects time and cost effective. Large and complex projects, however, can not be free from technical uncertainties. Technical innovations are often undertaken as new knowledge and information are available. What is more important is to have a design philosophy which enables flexibility in design, elimination of unnecessary and burdensome specifications, freezing of design before launching "manufacturing" or "procurement" and subsequent stages of the project cycle, and changes in the design to be made under most controlled conditions, using the concept of ISO 9000 for "documentation control".

Political interventions

Political interventions can be positive or negative. Political sponsorship is one of the single most critical success factors for the projects. Political overdominance generally reduces managerial efficiency but provides powerful government commitment to the timely completion of the project. On the other hand, where political leaders and government officials take over management functions upon themselves, projects suffer heavily on the fronts of time, cost and objectives. As long as the government plays the role of a sponsor, owner or a champion and allows freedom to the management and acts as a facilitator in decision making in matters of crucial importance, the projects are bound to succeed.

Community involvement

Public attitude towards major projects can not be ignored. The masses are becoming increasingly aware of the impact of the projects on their lives and surrounding environments. The project manager must evaluate the impact of the project on the community as a matter of first importance. If the project is not people and environment friendly, it will hardly meet the schedules. There are numerous examples of this kind in our country and elsewhere where projects were delayed because of public hostility. The role of media is also important to create the right impression about the project. For a project to be successful, the project manager will have to acquire the art and skill of public relations.

Projects were delayed because of public hostility.

Long project schedules

Major projects success is invariably jeopardized when the schedule duration is long as non can stop changes in the input prices, changes in the fiscal policies and regulations, changes in government itself, technical developments, organisational changes and a host of other changes over a long period. In a dynamic environment these changes are inevitable but they can alter the entire basis on which the project was formulated and designed. The other problem in project scheduling is to attempt "concurrency", i.e, initiating production activities prior to full scale design development. While concurrency affords shortening of duration, studies have, however, shown that in regard to projects with advanced technology, involving technical uncertainties and mismatching between technology and peoples capabilities, concurrency more often leads to project overruns. Despite these limitations, it has been found that maintaining schedule pressure is one of the most effective means of completing projects in time or with minimum possible overruns.

Financial aspects

Unrealistic estimates of financial outlays, lack of realistic provision for cost escalation and contingencies, hazy procedures of raising financial resources, inadequate risk analysis and lack of availability of funds when required are other important challenges to be faced for keeping the overruns under permissible limits. Cost escalation and exchange rates have been found as the two major factors for cost overruns.

Contracting strategies

Contracting strategies vary depending upon the expertise possessed by the owner and the nature of the project. The owner may have strong involvement in the management of the project and engage contractors on a well defined basis. On the other extreme, even the project management expertise may be contracted to a management or engineer consultant. There could be a

host of varying combinations between the two extremes. Projects, where owners have strong involvement in the management of their projects, have invariably succeeded with least cost overruns. The process of selecting the contractors to work on the project is of the utmost significance to success. It is important that contractors are brought into the project early so that both parties can get an effective feel of the project. This practice enables contractors' production expertise fed into the design and provides them sufficient time to properly appraise the risks. An essential aspect of contracting is to ensure motivation of contractors. Different projects have adopted different contract pricing practices, varying from fixed price contracting to cost-plus contracting. Fixed-price contracting is inappropriate in high risk situations. Where the risk is high, provision for cost recovery must be allowed. The risk should be put on to the contractor only to the extent that he is able to assess it logically and bear it financially. The contracting policy should be clearly established early in the project and once established it need not be immutable. Convertible contracting method is used in aerospace projects where prototype phase is often contracted on a reimbursable basis but later detailed development and production phases are done on some form of firm-price contract.

Projects, where owners have strong involvement in the management of their projects, have invariably succeeded with least cost overruns.

A conceptual model (Perry et al, 1982) correlating the risk and incentives between owner and contractor for different types of contracts is given in fig. 4.

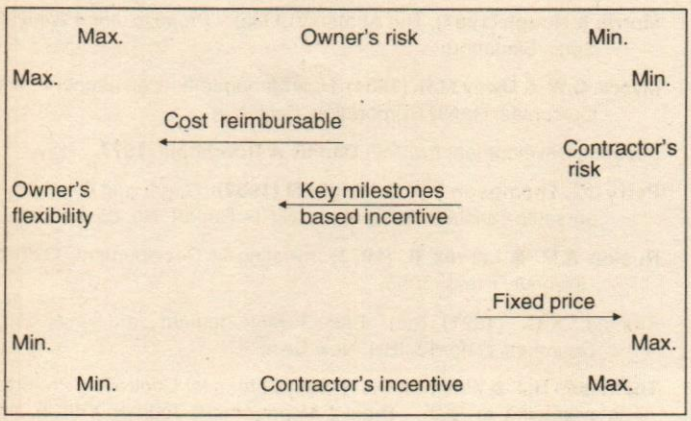


Fig. 4 : Correlation of risks and incentives between Owner and contractor

Project Organisation

The project organisation should be clear comprehensible and appropriate to the project. Essentially, three forms of Organisation are commonly found in projects - functional, project and matrix. It is not possible to say which is the best form. However, there is greater tendency to adopt project or matrix type organisation for larger projects. But there is a strong agreement among both researchers and practitioners that there should be one person or group in overall charge of a project, having strong overall authority, although the extent to which this is possible may be constrained by the form of contract employed and the 'culture' of the organisation. Leadership is another major factor for project success. Myers and Devey (1984) found leadership to be a significant factor in their study of process plants. Gemmil & Thamhain (1974) found a correlation between project success and experienced leadership when that leadership is coupled with strong top management support.

Ruskin & Lerner (1972) found some correlation between individual project administrators and cost overruns. Closely associated with leadership is the issue of teamwork. Projects are inherently flat organisations and teamwork is particularly important. Researchers in project management have put considerable emphasis on the importance of participative styles of decision making and conflict resolution in project teams (Martin & Eavendish, 1982).

Projects are inherently flat organisations and team work is particularly important.

Industrial relations can completely disrupt project implementation unless these are closely monitored and proactive actions taken. Communication is an essential part to keep healthy industrial relations. Communication has to be continuous and strong with all the participants - politicians, government agencies, contractors, suppliers, trade unions, own employees and community representatives. An interesting paper by Thamhain & Wilemon (1986) highlights the importance of these organisational factors. Whereas senior managers consider the causes of missed schedule and budget targets to be due to inadequate project definition, planning and control, the 'real' reasons, these researchers found, are in the 'social' areas, specifically: problems with organising the project team, weak leadership, communication problems, conflict and confusion and insufficient upper management involvement.

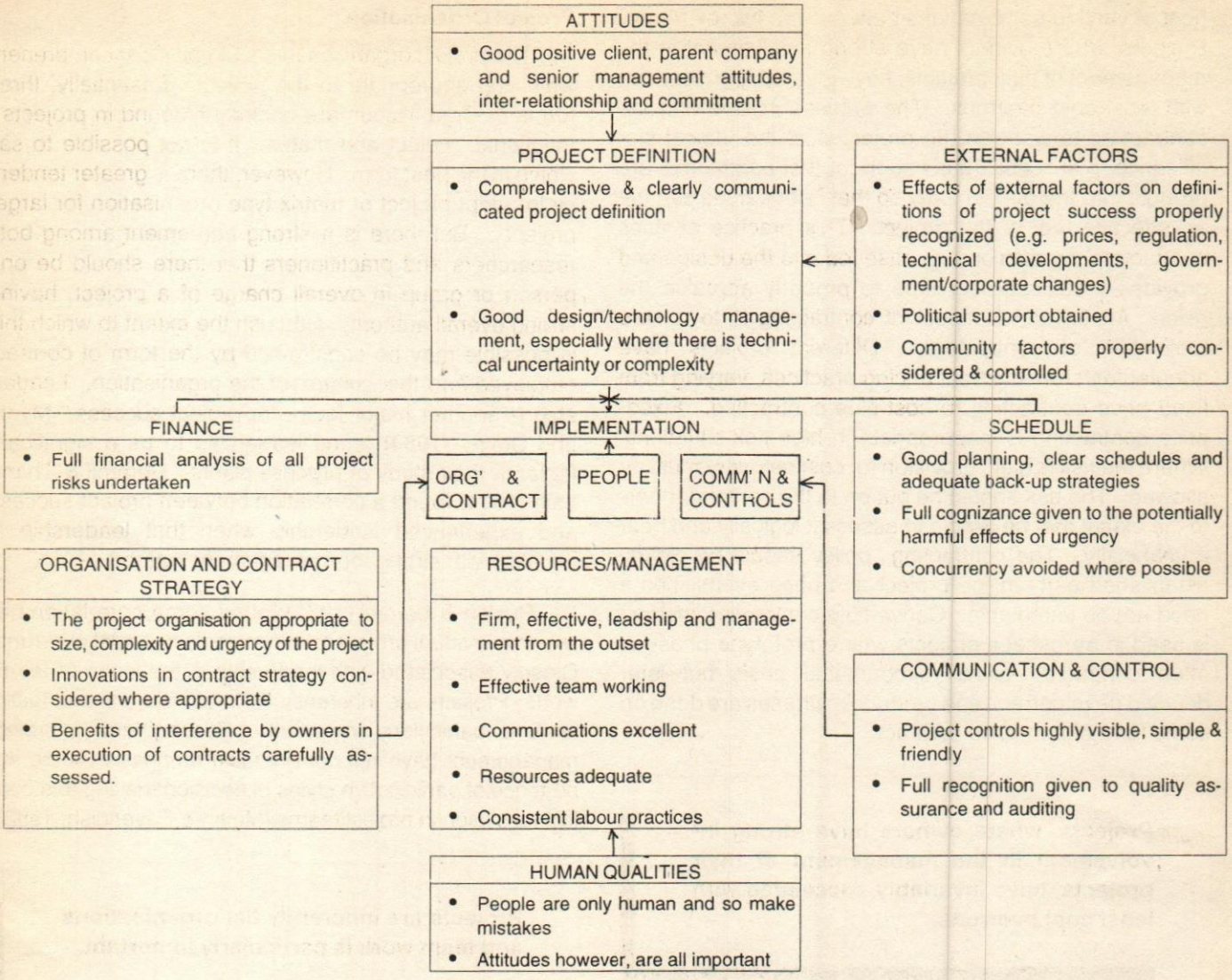


Fig. 5 : System Model for Project Success

System based model for project success

Though by and large the track record of major projects is not satisfactory, there are shining examples of successful major projects. A project must be treated as a system in totality, considering all possible aspects, internal and external to the projects and taking proactive actions to control them or minimize their adverse influence. Figure 5 presents a System Model— if all the factors referred in the model are taken care of adequately, their adverse impact on the project in terms of overruns is likely to be minimal, if not altogether eliminated.

References

Gemmil G & Thamhain H.J. (1974), Influence Styles of Project Managers: Some Project Performance Correlates. Academy of Management Journal, 17(2).

Martin M. & Cavendish P.C. (1982) Copying with cross cultural differences within International Project Environment. Proceedings of the 7th World Congress on Project Management, Copenhagen.

Morris & Hough (1987), The Anatomy of Major Projects, John Wiley & Sons, Singapore.

Myers. C.W. & Dwey M.R. (1984), How Management can affect Project Outcomes, RAND Corporation, California.

Planning Development Projects **Dannis A Rondinalli, 1977.**

Perry JG, Thompson P.A. & Wright M (1982), Target and Cost reimbursable construction Contract, CIRIA Report, No. 85, London.

Ruskin A.M. & Lervex R. (1972) Investing in Development, Oxford University Press, 1985.

Saxena, K.G. (1991) (ed), Project Management for Developing Countries, Oxford & IBH, New Delhi.

Thamhaim H.J. & Wilemon D.L. (1986) Criteria for Controlling Projects according to Plan. Project Management Journal XVII(2), pp 75-81. □

Project Management : New Ideas & New Methods

Basil E. Cracknell

In Europe, during the last decade, there has been a ferment of new ideas on project cycle management, leading to the new concept of Integrated Approach. This article looks at the new ideas and methods that characterise project cycle management among the European countries, notably (but certainly not exclusively) in relation to the projects and programmes in the developing countries, Eastern Europe and Russia/Ukraine. The underlying concepts and principles (if not necessarily the procedures themselves) comprise a "common language" that can facilitate communication between project analysts in both developed and developing countries concludes the author.

Basil Cracknell was formerly the Head of the Evaluation Department of the Overseas Development Administration, and Chairman of the Expert Group on Aid Evaluation of the OECD (DAC). He is currently an independent evaluation consultant.

Two trains of thought about project cycle management have been converging over the last decade. In the last two years they have been coupled together and have begun to run along the same track (Fig 1). The first is related to the issue of project preparation and project design, i.e. answering the question "What factors make for good project preparation and for ultimately successful projects?". The second train of thought relates to a different set of issues, and tries to answer the question "How can one systematically prepare projects so that they cover all the essential elements and possess internal consistency?". Obviously the two are closely connected, and it was only a matter of time before they became coupled together.

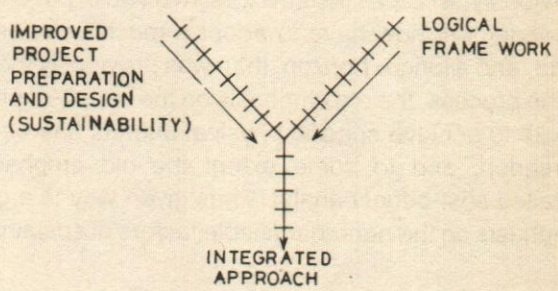


Fig. 1: Converging Ideas on Project Cycle Management.

Improving Sustainability

The common experience of European aid evaluators over the last decade or more has been that projects have often failed because of poor preparation. In particular, projects were being designed with overemphasis on the physical inputs and outputs, combined with an excessive reliance on economic (cost-benefit) calculations, whilst other key factors were generally overlooked. These key factors included: appropriateness of the technology to be used and the likelihood of adequate maintenance being

carried out; consistency with the social and cultural aspirations of the beneficiaries of the project; recognition of the role of women; robustness in the face of uncertainty and risk; degree of alignment with the recipient country's own policy priorities; and the likely impact on environment. Many aid-funded projects collapsed once the aid came to an end because these factors had not been adequately taken into account, i.e. they were not sustainable. The Expert Group on Aid Evaluation of the OECD (DAC), covering most of the main donors, identified the above factors (together with the traditional criterion of economic efficiency) as the key "Factors of Sustainability", and it was agreed that these should be systematically covered in every new project appraisal. Unless these factors are thoroughly considered and planned for at the very beginning of the project's life it is most unlikely that the project will be sustainable. When the aid dries up it will become obvious that the recipients' own policy priorities may be different from those on which the project was based; that no funds can be made available for adequate maintenance; that the donor-oriented technologies employed are inappropriate to the country's needs; that technical efficiency has been pursued regardless of the risk-awareness of the recipients, and so on. The project preparation formats now in use ensure that all these key issues are explored at the project design stage and not left until later on (or conveniently forgotten). The result is that the social development and environmental advisors now have a much greater role to play than previously, whilst all the advisors involved in project cycle management now have to adopt a much broader viewpoint, and a longer horizon, than was previously the case. In the process, the old emphasis on the supply of physical inputs to achieve specific physical outputs has been superseded, and to some extent the old emphasis on detailed cost-benefit analysis has given way to a greater emphasis on the non-quantifiable factors of sustainability.

Projects have often failed because of poor preparation with overemphasis on the physical inputs and outputs, combined with an excessive reliance on economic (cost-benefit) calculations.

Problem Identification & Project Analysis

The Logical Framework approach to project cycle management was first introduced in the United States in the late 1960's, but it is only in recent years that it has been widely adopted in Europe and in some developing countries. It comprises a simple 4 × 4 matrix as in Fig. 2.

	Intervention Logic	Objectively Verifiable Indicators	Source of Verification	Assumptions
Overall Objectives				
Project Purpose				
Results				
Activities		Means	Costs	
				Preconditions

(*Source*: "Project Cycle Management", Commission of the European Communities, February 1993)

Fig. 2: The Logical Framework Format

The Logical Framework is now used by the great majority of aid donors. In Europe the German aid agency GTZ has been practising (and teaching) the technique for about 20 years: the UK's Overseas Development Administration made the system mandatory for all new projects from 1985 onwards: and in the last two years the Commission of the European Communities has adopted the system on a mandatory basis. The main development banks also use it, as do some developing countries including India. The writer was privileged to run a series of Logical Framework Workshops in various parts of India, under the aegis of the NPC, in 1992, and he found that some of the participants were already aware of the technique and were proficient in its use. The developing countries have had to familiarise themselves with the Logical Framework because many donors insist on its use in project preparation.

To some extent the old emphasis on detailed cost-benefit analysis has given way to a greater emphasis on the non-quantifiable factors of sustainability.

Unfortunately the Logical Framework appeared on the scene in the wrong order. Ideally it should really have followed (rather than preceded) the development of improved techniques for problem identification (using Problem Analysis, Objectives Analysis and Strategy Analysis, as recommended by GTZ in the "ZOPP" approach). But the cart came before the horse. Now the primary need is to obtain a clear idea of what the problem is, i.e. by drawing up a "Problem Tree" and then seeing what alternative ways there are of tackling the problem and decid-

ing which is the best. Only when this process has been gone through should the Logical Framework technique come into play.

The Logical Framework is of course merely a technique. In itself it cannot ensure good projects: it is quality-neutral. For instance the Logical Framework as it stands does not even require the project analyst to cover the sustainability factors (although some agencies, like ODA, now require such factors as maintenance, the role of women, and environment, to be covered in every Logical Framework matrix). The clear need is to ensure that projects are not only prepared in a logical way but that they also cover the key sustainability factors. How to achieve this has been exercising the minds of those concerned with project cycle management in European aid agencies, and the most promising solution yet to emerge is the European Commission's "Integrated Approach".

The clear need is to ensure that projects are not only prepared in a logical way but that they also cover the key sustainability factors.

The Integrated Approach

The EC Commission has taken the bold step of linking together the two trains of thought regarding project cycle management into "The Integrated Approach" (Fig. 3). Items 3 to 8 are common to all stages of the project

Project Preparation	Implementation	Evaluation
1. Programming (project ideas)	1. Annual monitoring reports	1. Evaluation reports
2. Identification (pre-feasibility)		Interim
3. Appraisal (feasibility)		End-of-project
4. Dossier (financing proposal and agreement)		Ex-post
5. Plan of Operation	1. PROJECT DESCRIPTION AND OVERALL EVALUATION	1. SUMMARY
1. SUMMARY	1.1 Project/component description	2. BACKGROUND
2. BACKGROUND	1.2 Overall evaluation of sustainability	2.1 Government/sector policy
2.1 Government/sector policy	1.3 Possible additional EEC funding	2.2 Features of the subsector
2.2 Features of the sector	1.4 Delegate's comments	2.3 Beneficiaries & Parties involved
2.3 Beneficiaries and parties involved	2. COMMENTS/ACTION-Brussels	2.4 Problems to be addressed
2.4 Problem to be addressed	2.1 Comments	2.5 Other interventions
2.5 Other interventions	2.2 Action	2.6 Documentation available
2.6 Documentation available	3. INTERVENTION ACHIEVED/EXPECTED	3. INTERVENTION ACHIEVED/EXPECTED
3. INTERVENTION	3.1 Project purpose	3.1 Overall objectives
3.1 Overall objectives	3.2 Results	3.2 Project purpose
3.2 Project purpose	3.3 Activities	3.3 Results
3.3 Results	4. ASSUMPTIONS	3.4 Activities
3.4 Activities	4.1 Assumptions at different levels	4. ASSUMPTIONS
4. ASSUMPTIONS	4.2 Risks and flexibility	4.1 Assumptions at different levels
4.1 Assumptions at different levels	5. IMPLEMENTATION	4.2 Risks and flexibility
4.2 Risks and flexibility	5.1 Inputs-timing-award of contracts	5. IMPLEMENTATION
5. IMPLEMENTATION	5.2 Financing	5.1 Physical and non-physical means
5.1 Physical and non-physical means	5.3 Timetable	5.2 Organisation & implementation procedures
5.2 Organisation and implementation procedures	5.4 Pre-conditions-back-up measures	5.3 Timetable
5.3 Timetable	6. PROGRESS TOWARDS SUSTAINABILITY	5.4 Costs and financing plan
5.4 Costs and financing plan	6.1 Policy support	5.5 Special conditions/accompanying measures taken by the Government
5.5 Special conditions/accompanying measures taken the Government	6.2 Appropriate technology	6. FACTORS ENSURING SUSTAINABILITY
6. FACTORS ENSURING SUSTAINABILITY	6.3 Environmental protection measures	6.1 Policy support
6.1 Policy support	6.4 Sociocultural aspects/women in development	6.2 Appropriate technology
6.2 Appropriate technology	6.5 Institutional and management capacity (public and private)	6.3 Environmental protection measures
6.3 Environmental protection measures	6.6 Economical and financial analysis	6.4 Sociocultural aspects/women in development
6.4 Sociocultural aspects/women in development	7. MONITORING AND EVALUATION	6.5 Institutional and management capacity (public and private)
6.5 Institutional and management capacity (public and private)	8. CONCLUSIONS AND RECOMMENDATIONS	6.6 Economical and financial analysis
6.6 Economic and financial analysis		7. MONITORING AND EVALUATION
7. MONITORING AND EVALUATION		7.1 Definition of indicators
7.1 Definition of indicators		7.2 Reviews/evaluations
7.2 Reviews/evaluations		8. CONCLUSIONS AND RECOMMENDATIONS

Source: "Project Cycle Management" (Commission of the European Communities), Feb 1993.

Fig. 3: The Integrated Approach to Project Cycle Management

- Minimum damage to the existing installations
- Perfect tie-in and matching of the new facilities with the existing ones.

What should be done to achieve these end and how? The management of BFP should be approached with this question.

Involvement of O&M personnel from the beginning is with the dual purpose of: ensuring that the operation and maintenance of the existing plant are disturbed the least; and incorporating their experiences in the design and construction of the renovated new facilities

Coordination

Conflicts between the O&M personnel and construction personnel are common in BFPs. The success of project management in BFP, therefore, depends a great deal on the project manager's capability to handle conflicts. Although an integrated project team organisation can reduce conflicts, a BFP demands a tremendous amount of coordination among the departments of production, maintenance, services and utilities, engineering and project construction. Coordination should be a vital responsibility of the project team which is represented by all the departments concerned as rivalry between O&M and construction personnel in a BFP can strangle the production and also make the construction project fail.

Materials Management

In BFPs, the procurement and fabrication depend greatly on the extent of reusable old equipment and materials. The technology employed in the modernisation and the newly added facilities determines the use of existing critical equipment. So, planning for procurement should start with the evaluation of the suitability of the existing equipment with the new technology, the assessment of the usability of the equipment and materials, and identification and listing of the parts to be purchased/ fabricated and those to be rectified/modified/ refurbished. This assessment is to be done in three stages, namely, while considering the technology, on inspection of the existing plant before dismantling, and after dismantling.

Procurement involves additional activities of sorting, cleaning, checking, segregating, rectifying, modifying and refurbishing (hereinafter collectively called 'rectification'). Facilities and personnel necessary for carrying out these activities have to be organised before starting the dismantling. A workshop of the appropriate size, equipped with the necessary tools and plant should be set up, to do the rectification job at the site itself. The old parts that can be straightaway used without rectification must be cleaned, checked, greased or painted and marked with project code and/or part number for easy identification during erection. The same numbering method would apply also to the rectified items. For stacking and storing, the same logistics as applicable to a GFP shall be followed. After taking stock of the reusable equipment and materials, procurement of the remaining items shall be initiated in the same manner as in GFPs. Matching of the new supplies with the old ones in matters of performance data, maintenance and standardisation of spares and lubricants is an aspect to be taken care of by project engineering (PE).

Logistics in BFP materials management assume importance in view of the involvement of different classes of equipment and materials, in-plant transport bottleneck which is most common in BFPs, limited stacking and storing area and the need for simultaneous access to the old and new items of a particular segment at the time of erection. This calls for detailed logistic planning and careful implementation. BFP sites are generally congested. So, on-site distribution logistics at a BFP site, staying clear of production operations and connected traffic movements, demand meticulous attention.

Logistics in BFP materials management assume high importance in view of the involvement of different classes of equipment and materials, in-plant transport bottleneck limited storing area and the need for simultaneous access to the old and new items.

Shut-down planning

During modernisation activities, production operations and services continue in vital industrial and infrastructural plants and facilities. For example, a major steel plant cannot be totally shut down for 3-4 years to modernise/renovate a few sections or segments or add some more facilities. Only essential minimum shutdowns shall be taken to facilitate construction, so that production loss is kept to the minimum and movement of goods continues. There are two categories of shutdowns — a temporary shut-down to facilitate some construction activity and, the permanent shut-down of a unit to dismantle and rebuild the unit itself.

Shut-down planning shall cover production, units, traffic movements, power and water supply and other utilities. This planning should be done jointly by the rep-

resentatives of all the departments concerned, using a meticulously calender-time-phased network, with perfect coordination communication among the members of the project team. Unplanned shut-downs as well as refusal or failure to give the schedule of planned shut-downs can cause a lot of disorder and delay in the construction activities. Besides slippage of schedule and the resultant financial loss, they can also lead to harmful conflicts between departments. So, it is desirable that shut-down planning decisions are taken with the involvement of all the departmental heads of the enterprise at the site, and the Project Manager monitors it. Decisions on permanent shut-down should be taken with the approval of the CEO. If any change in the plan becomes inevitable because of unavoidable production exigencies, a revised planning should be done sufficiently in advance, involving all the departments and team members concerned, so that the construction plan can be suitably adjusted in time, without resources idling.

Capital Repairs During Modernisation

When a plant unit is scheduled to be shut down permanently for modernisation in the near future, it is usual to operate it with only the routine running maintenance, without any expensive capital repair. But, if the schedule goes haywire and the shut-down is delayed, the unit's efficiency dwindles without capital repairs, and thus, its operation becomes expensive with diminishing output. On the other hand, a capital repair just before a permanent shut-down can prove to be a wastage. The solution to this problem is strict control on shut-down schedules and construction schedule.

Construction Management

Construction management (CM) practices in both GFPs and BFPs are basically the same. But the nuances of brown-field project have a significant influence on every aspect of CM in a BFP. The strategy is to prepare a checklist of all CM activities, study each of them with reference to the practices and requirements of the operating units and the constraints of the brown-field, and then modify their modus operandi so that they can be accommodated despite the constraints in the activities. CM can benefit from the existing organisation, infrastructure and management practices which can simultaneously serve both the production and construction activities. The total requirements of the modernisation project's resources and CM practices shall be listed out and compared with what is existing, to identify what parts of existing organisation, infrastructure, capital equipment, maintenance facilities, communication network, general office services, systems and procedures, office equipment, logistic arrangements, insurance and risk management, legal aid, etc., can be made use of economically in the construction. After such identification, the project team shall approach the top management and get the necessary executive orders issued, so that various heads of departments throw open their doors to the team to avail of the required resources and service. Integrated team work can save the construction cost considerably by making optimum use of the existing resources and services in different areas. The construction department should not work in isolation. In addition to the integrated project team consisting of members of all the departments concerned, the PM and/or the CM should interact daily with the heads of other departments, so that no problem remains unresolved for more than a day and the resources of the total enterprise are available to the project team to perform efficiently and maintain the construction schedule.

Integrated team work can save the construction cost considerably by making optimum use of the existing resources and services in different areas.

A few aspects which need particular attention in the management of a BFP construction are safety, security environmental protection and welfare facilities.

Safety

Employees, third parties, construction equipment and existing installations are more susceptible to accidents in a BFP than in a GFP, because of congestion and simultaneous multiple operations. Production, dismantling construction, all taking place side by side, with all the related work operations, traffic movements and services, increase the chances of accidents. Excavation in areas where there are underground power cables and service lines can be hazardous. All these dangers can be averted only through intensive training in safety practices, strict implementation of safety codes, and vigilant supervision. The whole team has to be conscious of this requirement, with the management including safety in the list of matters needing topmost attention.

Security

The presence of numerous construction workers in the plant precincts and hundreds of vehicles of all categories playing in and out is a potential threat to the security of the plant and the enterprise's goods and per-

sonnel. Controlling the entry and exit of a few thousand more men than usual in the operating plant, keeping watch on their movements and behaviour in the plant area, checking the documents and contents of each and every vehicle, documenting the goods brought in and taken out, including debris and scrap of the dismantled units and excavated earth, and ensuring the security of the installations and the owner's movable properties is a challenging task to be handled with considerable intelligence and care, in a BFP situation. A number of additional gates may have to be opened to serve the requirements of the construction. For sending out debris and excavated earth, a separate gate can be earmarked with the appropriate facilities to check materials being concealed and smuggled out. An able team of trained security personnel headed by a very senior executive who has direct access to the CEO should be entrusted with the security administration of a large BFP.

Environmental care

Dumping of dismantled debris, plying of numerous vehicles, movement of wagons, obstructions and defacements caused by congestions and diversions, housing and sanitation needs of the construction work force temporarily brought in, etc., pose threats to the environment. The designers and planners must do the necessary planning for environmental protection sufficiently in advance. The environment needs additional protection during the construction period over and above the permanent measures of protection that go with the selection of technology, design, operation and maintenance of the plant.

Welfare

Welfare facilities built inside the plant suddenly face an enormously enlarged demand with the influx of the construction work force. Facilities like washing area, urinals and lavatories, drinking water supply, canteens, resting places, first-aid centres, hospital, bicycle parking place, creche, etc., come under the strain of such a demand. The project planners have to take necessary measures sufficiently in advance to supplement the facilities suitably so that the existing O&M employees do not become discontented, and the construction men get at least the minimum facilities at the site.

Plant Relocation Projects

A plant relocation project (PRP) has the characteristics of: a GFP in matters of studies, clearances and civil works; a BFP in procurement and materials management; and its own unique features in engineering, layouts, logistics, erection, and commissioning.

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The principal stages in the implementation phase of a PRP are :

- Studying the as-built drawings and documents of the existing plant
- Completing the as-built drawings by making up the missing ones, to actual measurements of the existing plant
- Critical visual inspection of the plant, to identify the components to be replaced
- Comparative study of the old site and the new site, and layout decision
- Decision on modifications and additions to the plant for optimisation and/or modernisation of the products, and designing the same before the start of dismantling
- Civil works and infrastructure construction
- Marking the equipment and components in-position, segmentwise with reference to drawings and bills of materials
- Dismantling
- Segregation between reusables, and the rejected
- Disposal of rejects and debris
- Sorting out the reusables between directly reusable after the customary cleaning and painting/greasing, and those to be rectified/refurbished
- Logistics planning
- Packing and despatching the reusables to the new site
- Procurement of replacements as well as spares and components needed for rectifications and modifications, and new equipment for additions
- Rectification, refurbishing, calibration and preservation
- Erection
- Commissioning, start-up, and stabilisation.

Some of these aspects which are peculiar to PRPs need to be discussed here.

Studying As-Built drawings and Documents

Relocation involves broadly, dismantling, transportation to a new location and rebuilding of a working plant. It is necessary that these three main tasks and the many activities connected with them are carried out carefully to ensure the plant's trouble-free performance at the new location. Before dismantling the plant, it is necessary to study the as-built drawings and documents to know the history, specifications and final design of the plant as a whole. Simultaneous inspection of the plant in the old location on 'as-is-where-is' condition or in the operating condition gives a very clear concept about the plant's design, construction and operation. Such a study also helps in visual identification of the components to be replaced and/or repaired after dismantling and in doing the design work for the same, and initiating major fabrication, even before the start of dismantling. Among the as-built drawings if there is any missing link, such a link could be easily established by visual inspection and actual measurements before the plant is dismantled. As-built drawings and documents reduce the engineering and design work and facilitate the completion of the design drawings by actual measurements. They facilitate easy re-erection as well.

If the owner has not preserved the as-built drawings, they have to be prepared before dismantling the plant.

Comparative Study of the Two Sites

The as-built layout drawings of the plant shall be brought to the new site and the layout possibilities at the new site studied with reference to it. It is not possible to maintain the same layout and orientation at the new site for some reason, then the layout changes can be best planned before dismantling the plant. Similarly, if modifications or additions of some facilities are desired, they can also be easily designed before dismantling and plant the after comparative study of the two sites.

Dismantling & Sorting

A systematic method of dismantling and sorting shall facilitate the subsequent stages of work:

- Mark all parts with the numbers of the drawings and bills of materials before dismantling.
- After dismantling, segregate and stack all components according to plant segments or project codes.
- Clean the components, inspect and segregate them between reusables and rejects.
- List the rejected components for ordering their replacement supplies, and make doubly sure that their drawings are available.
- Sort out the reusables into two classes, namely those directly reusable after the necessary painting or greasing, and those to be rectified/refurbished.
- Dispose of the scrap, and pack the reusables in separate lots, with the above-mentioned classification marks, for despatch.

Logistics

In the logistics of the dismantled plant, the following additional care shall be taken:

- For despatching long and bulky items to the new site, envisage the minimum number of cutting at the old site and rewelding at the new site.
- As a sequential despatch of the reusables to suit re-erection is not practicable, plan a vast storage area at the new site with segmentwise storage facility, making provision for receiving replacement supplies at the relevant earmarked segment areas.

Procurement & Refurbishing

Procurement of new equipment and materials needed for modifications, additions and replacements, and those for refurbishing of reusables are better handled separately. While the manufacture and fabrication of the new items may be ordered outside, it is advantageous if rectifications and refurbishing are done at the site under the close supervision of specialists. To supervise the refurbishing of sophisticated equipment, it may sometimes be necessary to call the manufactures' technical experts. Refurbishing and rectification facilities have to be built at the site. For imported second hand plant, much rectifications and replacements may not be necessary because of the regulatory requirement that the plant must have a certain minimum number of years of good residual life, supported by expert certification, as per import regulations. Modifications and upgradations are different matters.

Erection & Commissioning

Re-erection of a relocated plant is a very easy task if the parts are properly marked and stacked segmentwise with easy retrievability, and the as-built drawings and documents are available. The use of engineer time in PRP erection is much less than that in GFP and modernisation projects. The re-erection of relocated plant is, practically, like re-assembling a knocked down kit. Even commissioning is easy because the plant was working in the previous location. If a new technology is introduced, the previous commissioning data and documents, (if available), make the task easier. □

AHP Application for Project Selection Decision

Kampan Mukherjee & Anil Kumar Jha

Project selection is rendered complex by the involvement of multi-dimensional factors directly or indirectly influencing the decision situation. In the pursuit of solving this multi-objective decision problem. Analytic Hierarchy Process (AHP) has been identified as the most efficient method due to its unique incorporation of both qualitative as well as quantitative factors and detailing of the problem by a hierarical mode. A mine project selection problem is taken up as a case study and solved by applying AHP technique.

Kampan Mukherjee & Anil Kumar Jha are from the Department of Industrial Engineering & Management, Indian School of Mines, Dhanbad 862004.

Large and complex projects undertaken by the public sector in various fields of activities have been imposing severe strain on the country's economy, particularly because of improper selection of projects. Project selection is most significant in a developing country like India, in view of the constraints on capital and skill. In order to make a rational distribution of limited financial resources it is imperative to identify and select those projects which are to be given preference over others competing for the same resources.

Project selection is most significant in a developing country like India in view of the constraints on capital and skill.

For the selection of suitable project(s) the first step is its evaluation. The sets of alternatives and criteria have to be known and established before the selection process commences. Evaluation of any project is made under some criteria of optimisation. Formal techniques used for selecting the best project are based on certain figure of merits. However, in real life situations, problem arises due to conflicting criteria/objectives and a compromise solution is sought as simultaneous optimisation of all objectives is not possible. If there exist more than one criteria of optimisation the problem is of multi-criteria decision type. In a single criteria/objective problem, the selection process can be managed with relative ease even if there are a large number of alternatives. in decision analysis of complex systems multiple criteria are used. Multi-Criteria decision problems are further divided into two groups, namely, Multi-Objective Decision Making (MODM) and Multi-Attributes Decision Making (MADM) (Tabucanon, 1988).

Characteristics of Mine Projects

A project is a proposal for an investment to create, expand and/or develop certain facilities in order to increase the production of goods and/or services in a community during a certain period of time. Basically projects can be divided into two major groups namely producing and Non - Producing (Pandey, 1991). Mine projects fall under the former category. Further, Mine projects can be grouped as follows:

New Project: No previous investment.

Augmentation Project: To improve the production and productivity of the existing mine by employing additional resources. Additional resources may be in the form of men, material, machine, money, technology etc.

Reconstruction Project: To run the mine, additional infrastructure is required. The basic design of the original system may change.

Revamping Project: To restart the idle mine after removing the bottlenecks by repairing or replacing the infrastructure or machinery due to which the mine was idle.

Re-organised Project : To improve the production and productivity of the mine by re-organising and re-orienting the available resources without employing additional resources.

A project is a proposal for an investment to create, expand and/or develop certain facilities in order to increase the production of goods and/or services in a community during a certain period of time.

Factors influencing Mine Project Selection

Factors which influence the selection of mine project may be enumerated as follows:

Economic Factor: Capital investment, operating cost, selling price etc.

Technological Factor: Degree of mechanisation, availability of spare parts, availability of skilled manpower etc.

Environmental Factor: Degree of pollution (dust, water, noise), damage of land, impact on ecology and social system.

Safety Factor : Gassiness, strata condition, geological disturbances, inundation problem etc.

Social Factor : Job opportunity created, damage of land, pollution etc.

Political Factor : Government regulation, import/export policy, general energy policy, national economic policy etc.

Criteria for Mine Project Selection

Criteria are measures, rules and standards that guide decision making (Tabucanon, 1988). The following criteria should be considered for selecting the mine projects.

Objective Criteria

Minimisation of capital investment

Minimisation of foreign exchange requirement or Maximisation of foreign exchange earning

Minimisation of operating cost

Maximisation of profit

Maximisation of NPV

Maximisation of internal rate of return (IRR)

Maximisation of return on investment (ROI)

Maximisation of production & productivity

Maximisation of average rate of return etc.

Subjective Criteria

Maximisation of employment opportunity

Maximisation of social benefit

Maximisation of good relationship with employees and customers

Maximisation of image of organisation

Minimisation of accident due to water, strata, fatigue etc.

Minimisation of environmental hazard

Minimisation of damage of land

Minimisation of pollution

Minimisation of impact on ecology and social system etc.

Case Study on Mine Project Selection

From a large coal mining company, three projects were identified and detailed feasibility reports prepared. The projects were different in terms of techno-economic, and other factors. Due to the complex value system of the management of this public sector company, the selection criteria comprised a set of factors, some of which

Table 1: Description of Problem

Particulars	Unit	Alternatives		
		P-1	P-2	P-3
Capital Investment	Rs. Crores	33.53	87.49	69.48
Rated Capacity	TPD	1700	3000	2400
Specific Investment	Rs./t	644.87	972.11	1029.26
Operating cost	Rs./t	248.43	307.19	429.63
Profit/Loss	Rs.	17.57	37.37	40.37
Return on Investment	%	6.93	2.9	10.65
IRR	%	5.29	6.67	13.8
Foreign Exchange Requirement	Rs. Crores	NIL	19.47	2.13
Method of Exploitation		OCP with Shovel & Dumpers	Sub level caving L/W face with power support	Long wall face with hydraulic support
Manpower	NO.	438	1985	1880
OMS	T	4.72	1.66	1.47
Land requirement	HA	63	12	31
Degree of Pollution		HIGH	MEDIUM	LOW
Employment opportunity		LOW	MODERATE	HIGH
LIFE	YEARS	8	23	18

were conflicting in nature. The case study was aimed at selecting a project in such a complex decision making situation. Analytical Hierarchy Process (AHP) technique was applied for solving this project selection problem. AHP technique, developed by Saaty (1990) has gained popularity among researchers and practitioners of MADM. It constitutes the following steps:

- Representation of the decision problem in the form of a hierarchy as a result of detailed analysis of the problem.
- Evaluation of items of the hierarchy on the basis of a paired-comparison, which represents judgements of decision makers.
- Qualitative assessment of not only the projects, but also the criteria, incorporating their contribution to the decision problem.

The data related to the projects were collected and compiled from detailed feasibility reports (Table 1).

Structuring of the Problem

Analysis of the management system initially led to the identification of three factors, viz. the economic, technological and environmental factors for the evaluation of projects. Seven criteria viz. IRR, Profit/t, ROI, Foreign - Exchange Requirement, Degree of Mechanisation, Damage of Land, and Degree of Pollution related with these factors were taken into consideration. The hierarchic structure of the problem is illustrated in Fig. 1. The problem is divided into four levels. At "0" (top) level is the overall goal of "selection of project". In level-1 and level-2 are the three factors and the several criteria respectively, which contribute to the goal and the third level comprises the three projects which are to be evaluated in terms of the criteria in the second level.

Pairwise Comparison Judgements

The second step is the elicitation of pairwise comparison judgements. The factors in the first level are arranged in the form of a matrix and judgements are drawn from the decision maker/expert. The scale for making the judgements is given in table 2.

Table 2: Fundamental Scale

Intensity of Importance on an absolute scale	Definition	Explanation
1	Equal importance	Both activities contribute equally to the objective
3.	Moderate importance of one over another	Experience and judgement strongly favour one activity over another
5	Essential or strong importance	Experience and judgement strongly favor one activity over another
7	Very strong importance	An activity is strongly favored and its viability demonstrated in practice.
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation.

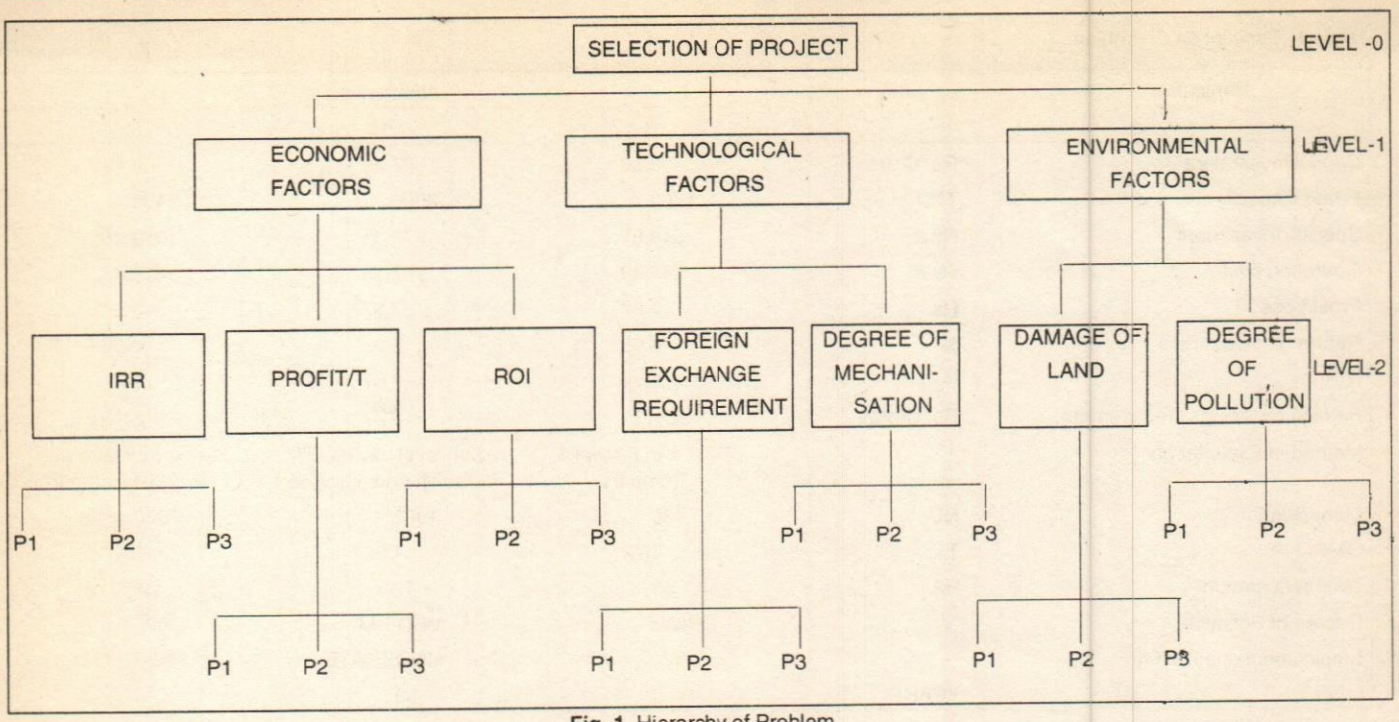

Fig. 1 Hierarchy of Problem

When comparing two factors the issue to be analysed is: "Of the two elements being compared, which is considered more important by the decision maker/expert with respect to the overall goal of selection of project?" The matrix of pairwise comparisons of the factors given by the expert in this case has been shown in table (3a). In the same manner the pairwise comparison matrix is prepared for level - 2 (criteria level) as shown in table 3(b). Next we move to the pairwise comparisons of the elements in the lowest level. The elements to be compared pairwise are the projects with respect to how much better one is than the other, with reference to each criterion in level - 2. Thus there will be seven 3×3 matrices of judgement, since there are seven criteria in level-2 and three projects to be pairwise compared for each criteria. These seven matrices are shown in table 3c.

Table 3a: Pairwise comparison matrix for level - 1

	Economic	Techno	Envirn.
Economic	1	3	7
Techno	1/3	1	3
Envirn.	1/7	1/3	1

Table 3b: Pairwise comparison matrix for level - 2

For Economic Factors:

	IRR	Profit/T	ROI
IRR	1	3	1/5
Profit/T	1/3	1	1/7
ROI	5	7	1

For Technological Factors:

	FE Reqd.	Degree of mech.
FE reqd.	1	5
Degree of mech.	1/5	1

For Environmental Factors:

	Degree of Pollution	Damage of Land
Degree of Pollution	1	5
Damage of land	1/5	1

Table 3c: Pairwise comparison matrix for level - 3

For IRR:

	P-1	P-2	P-3
P-1	1	1/4	1/7
P-2	4	1	1/5
P-3	7	5	1

For Profit/T:

	P-1	P-2	P-3
P-1	1	1/3	1/7
P-2	3	1	1/5
P-3	7	5	1

For ROI:

	P-1	P-2	P-3
P-1	1	4	1/5
P-2	1/4	1	1/8
P-3	5	8	1

For Foreign Exchange requirement:

	P-1	P-2	P-3
P-1	1	4	9
P-2	1/4	1	7
P-3	1/9	1/7	1

For Degree of mechanisation:

	P-1	P-2	P-3
P-1	1	1/6	2
P-2	6	1	4
P-3	1/2	1/4	1

For Degree of pollution:

	P-1	P-2	P-3
P-1	1	1/5	1/6
P-2	5	1	1/2
P-3	6	2	1

For damage of land:

	P-1	P-2	P-3
P-1	1	1/8	1/4
P-2	8	1	5
P-3	4	1/5	1

Calculation of Local Priorities

The local priorities for elements in level - 1, 2 & 3 are computed as follows: Each column element of matrix is divided by its column total and then the average of the elements in each row is computed, which gives the local priority vectors.The local priority vectors for each level is computed and shown in table 4(a), 4(b) and 4(c). In this computation \max should be exactly equal to matrix size i.e. 3, in case of absolute consistent judgement of the decision maker. However, in reality, it is never so. A Consistency Index (CI) is computed for testing the consistency of decision maker's judgement (Tabucanon, 1988).

Table 4a: Calculation of Relative priority for level - 1

	Economic	Techno	Envirn.	Priority vector
Economic	0.678	0.692	0.636	0.669
Techno	0.226	0.231	0.243	0.243
Envirn.	0.096	0.077	0.091	0.088

\max. = 3.01
CI = 0.005

Table 4b: Calculation of relative priority for level - 2
For Economic factors:

	IRR	Profit/T	ROI	Priority vector
IRR	0.158	0.277	0.149	0.193
Profit/T	0.053	0.091	0.106	0.083
ROI	0.789	0.636	0.745	0.724

\max. = 3.315
CI = 0.0675

For Technological factors:

	FE reqd.	Degree of mech.	Priority vector
FE reqd.	0.833	0.833	0.833
Degree of mech.	0.167	0.167	0.167

\max. = 2.002
CI = 0.002

For Environmental factors:

	Degree of pollution	Damage of land	Priority vector
Degree of pollution	0.833	0.833	0.833
Damage of land	0.167	0.167	0.167

\max. = 2.002
CI = 0.002

Table 4c: Calculation of relative priority for level - 3
For IRR:

	P-1	P-2	P-3	Priority Vector
P-1	0.083	0.040	0.106	0.077
P-2	0.333	0.160	0.149	0.214
P-3	0.583	0.800	0.745	0.709

\max. = 3.265
CI = 0.132

For profit/T:

	P-1	P-2	P-3	Priority vector
P-1	0.091	0.053	0.106	0.083
P-2	0.273	0.158	0.149	0.193
P-3	0.636	0.789	0.745	0.724

\max. = 3.141
CI = 0.071

For ROI:

	P-1	P-2	P-3	Priority vector
P-1	0.160	0.308	0.151	0.206
P-2	0.040	0.077	0.094	0.070
P-3	0.800	0.615	0.755	0.723

\max. = 3.204
CI = 0.102

For Foreign ex. requirement:

	P-1	P-2	P-3	Priority vector
P-1	0.735	0.778	0.529	0.681
P-2	0.184	0.194	0.412	0.263
P-3	0.082	0.028	0.059	0.056

\max. = 3.289
CI = 0.144

For Degree of mechanisation:

	P-1	P-2	P-3	Priority vector
P-1	0.133	0.118	0.286	0.179
P-2	0.800	0.706	0.571	0.692
P-3	0.067	0.176	0.143	0.129

\max. = 3.293
CI = 0.147

For Degree of pollution:

	P-1	P-2	P-3	Priority vector
P-1	0.083	0.063	0.100	0.082
P-2	0.417	0.313	0.300	0.343
P-3	0.500	0.625	0.600	0.575

\max. = 3.048
CI = 0.024

For Damage of Land:

	P-1	P-2	P-3	Priority vector
P-1	0.077	0.094	0.040	0.070
P-2	0.615	0.755	0.800	0.723
P-3	0.308	0.151	0.160	0.206

\max. = 3.204
CI = 0.02

Establishing Composite Global Priorities

We lay out the local priorities of the projects with respect to each criterion in a matrix and multiply each column of vectors by the priority of the corresponding criterion and add across each row which results in the desired vector of each project (table 5). On the basis of the global/composite priorities, the importance of the projects may be revealed as following.

RANK	PROJECT
I	P - 3
II	P - 1
III	P - 2

Analysis of the Result

Project 3 (P - 3) which was the least desirable with respect to Foreign Exchange Requirement and Degree of Mechanisation had the largest priority and has got Rank-I. Project - 1 (P - 1), which was less desirable compared to project - 2 (P- 2) with respect to IRR, Profit/t, degree of mechanisation, damage of land, degree of pollution, has got higher rank than project - 2, because of the fact that p - 1 is more desirable than p - 2 with respect to RIO and Foreign Exchange requirement, which have higher contribution towards the overall goal of project selection.

References

Pandey, I.M, "Financial Management, Vikas publishing House Pvt. Ltd, Revised Edition - 1991.

Saaty Thomas L, "How to make a decision : The Analytic Hierarchy Process", *European Journal of Operation Research,* 48 (1990) 9-26, North Holland

Tabucanon, M. T, "Multiple Criteria Decision Making in industry" *Elsevier,* 1988.

Table 5: Step III. Project Selection: Local & Global Priorities

	ECONOMIC (0.669)			TECHNOLOGICAL (0.243)		ENVIRONMENTAL (0.088)		OVERALL PRIORITY
	IRR (0.193)	Profit/T (0.083)	ROI (0.724)	Foreign Ex. reqd. (0.833)	Degree of mech. (0.163)	Damage of Land (0.163)	Degree of pollution (0.833)	
	0.129	0.056	0.484	0.202	0.041	0.015	0.073	
P-1	0.077	0.083	0.206	0.681	0.179	0.082	0.07	0.266
P-2	0.214	0.193	0.07	0.263	0.692	0.343	0.723	0.212
P-3	0.709	0.724	0.723	0.056	0.129	0.575	0.209	0.522

Factors Influencing Project Success at R&D/Production Interface

Lakshmanan Prasad, Albert H. Rubenstein & Walter P. Murphy

This study analyses the impact of radicalness of a project's technology, project salience, interpersonal dynamics, project specific politics, and individual commitment on successful technology transfer from R&D to manufacturing. Results of a stepwise discriminant analysis, using a dichotomous successful-problematic outcome classification, show that "successful" projects are those in which individual commitment is high, and organizational politics and radicalness of technology are low. Further analysis indicates that, for "problematic" projects, difficulties hindering efforts to start and expand production, or modify the product to facilitate maintenance, were probably compounded by the turnover of key project personnel.

Lakshmanan Prasad is a Visiting Professor, Indian Institute of Management, Bannerghatta Road, Bangalore 560 076. Albert H. Rubenstein & Walter P. Murphy are from the Department of Industrial Engineering and Management Sciences. The Technological Institute Northwestern University, Evanston, I1 60201.

While there has been a number of empirical studies on factors influencing the success and failure of technological innovations in manufacturing organizations (Baker et al, 1984; Booze, 1982; Cooper, 1979; Lilien & Yoon, 1989; Madique & Zirger, 1984; Myers & Marquis, 1969; Rothwell, 1974; Rubenstein et al, 1976; Von Hippel, 1977; Yoon & Lilien, 1985). Only a few of them have focussed exclusively on the R&D-Production interface (Bergen et al, 1988; Ginn, 1983; Ginn & Rubenstein, 1986; Souder & Padmanabhan, 1989). This is probably because financial, marketing, and strategic issues are more glamorous than production related topics, particularly to the proponents of a post-industrial society. This neglect is unfortunate, especially when U.S. manufacturing could yet become the Cinderella of the international competitiveness ball. To address this gap in the literature, we conducted a major research study on the role of an organization's imbedded technological capabilities in facilitating the development and transfer of new products and processes from R&D to Manufacturing. The results of the research study on the R&D/Production interface highlight the short-term, operational issues of getting new and improved products and processes "out of the door," rather than the longer-term policy level objectives of maintaining and strengthening the R&D/Innovation process in the company and adding to its technology base. The focus is on barriers to quick, cost-effective and technically sound transfer from R&D to Manufacturing, and the exchange of ideas, needs, information, advice and technological options that accompanies this process.

The R&D/Production interface is a temporal, spatial, and functional concept which represents the organizational and interpersonal (managerial and professional) exchange of information and know-how. In many cases, production people may be viewed as receivers of technology from R&D. Therefore, the interface is a part of the R&D/Innovation spectrum which can be an arena for

cooperation or conflict; a generator or repository for ambiguity about locus of responsibility; and a source of high costs, delays, and technical difficulties. When the interface works smoothly and quickly, products and process seem to slide effortlessly through. When it does not, intraorganizational (interdepartmental or interdivisional) technology transfer falters and often breaks down.

The R&D/Production interface is a temporal, spatial, and functional concept which represents the organizational and interpersonal (managerial and professional) exchange of information and know-how.

Methodology

The general strategy for this study involved theory-based field research, driven by a set of *a priori* propositions (Figure 1). The propositions were generated from a set of potentially researchable questions, related to the R&D/Production interface in industrial firms. R&D Project was selected as the unit of analysis. This unit has been commonly used for many other studies and surveys of the R&D/Innovation process, and could therefore provide some basis for comparisons.

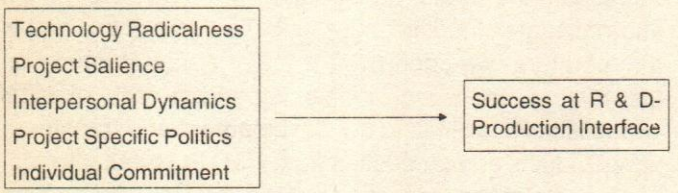

Fig. 1: The Conceptual Framework

Many studies of the R&D/Innovation process involve top managers of companies or bench level engineers and scientists as principal respondents. For this study on the R&D/Production Interface, the personnel who were or had been close enough to the phenomenon to be knowledgeable about it and were accessible to an outside research team were selected as respondents.

Although it would have been desirable, methodologically, to have involved a larger number of respondents for each project (the modal number of respondents per project was 3), the realities of the field situation did not allow for this. The constraint was finding people close to a focal project who were knowledgeable about the circumstances of its transition across the R&D/Production interface. After gaining access to a field site, an individual was identified as the gatekeeper to coordinate access to the organization and collection of data. He helped resolve procedural issues related to the study and in addition, also completed a Background (BKGD) questionnaire, covering a number of organization level variables.

Once the BKGD questionnaire had been filled in, the Gatekeeper was asked to identify two or more projects for detailed investigation — one "successful" and one "problematic" candidate, in terms of how smoothly the project had been or was being transferred from R&D to production. The choice of "problematic" instead of "unsuccessful" was deliberate, and not an euphemism as the emphasis was on evaluation of technical results at the interface, rather than subsequent economic or marketing outcomes. Where the gatekeepers had trouble identifying problematic projects, they were asked to consider any "ugly ducklings" - i.e., those projects that had experienced difficulty going through the R&D/production interface, even if they were later considered technically and/or commercially successful. In some cases, more than two projects were available, and, where feasible, included in the sample. However, some gatekeepers did not want to identify "problematic" projects, probably for various political reasons. In some of these field sites, only one project was selected, while in others two successful projects were chosen.

Every attempt was made to talk to the manufacturing personnel associated with the project in order to get the "other side" of the picture also. However, it was possible for only about one-third of the projects. In the rest, the manufacturing personnel were inaccessible as they were not in Chicago or its vicinity or had left the company and were untraceable; other specific reasons related to the stage the project was in at the time of the study. Whenever the manufacturing facility was not in the area, attempts were made to interview individuals when they came to Chicago to meet with R&D personnel. In other cases, the instrument was mailed to the individuals and they were then contacted over the phone. By and large, these alernative approaches were not very successful. Only in two cases, where the Division's General Manager or the executive in charge of R&D personally sent out a memo, did the manufacturing personnel return the instruments. In one of these cases, the data were so incomplete that it was not included in the final analysis.

Data Analysis & results

Two measures of the depndent variable — "Success at the R&D/Production interface" — could have been used. The first was a global indicator of effectiveness,

reflected in the selection of the focal projects at each site. The other measure of success at the R & D/Production interface was made up of 14 items (table 1). It included indicators of relative satisfaction with such factors as technical bugs, unexpected process adjustments, variability in product quality, sensitivity of product to changes in materials, delays in start-up, after-sales problems, modifications needed downstream, success in meeting deadlines, cost overruns, etc. Data were provided by project managers and production personnel associated with the project. given the general agreement between the gatekeepers and project managers in classifying project outcomes, we could have chosen either alternative. For the first part of this analysis, we decied to go with the gatekeeper's dichotomous classification of projects as "successful" or problematic." In the second part, we analysed the "satisfaction" variable.

Table 1: Satisfaction with project

	Model Project				Worst Project	
Extent to which technical "bugs" affected production and upscaling	NA	1	2	3	4	5
Extent to which desited performance specifications were achieved by initial production samples	NA	1	2	3	4	5
Extent to which unexpected process adjustments were required to ensure smooth production runs	NA	1	2	3	4	5
Extent of variability in product quality	NA	1	2	3	4	5
Sensitivity of product to changes in raw materials or component variability	NA	1	2	3	4	5
Extent and seriousness of delays in achieving desired production volume after initial start-up	NA	1	2	3	4	5
Extent and seriousness of after-sales problems	NA	1	2	3	4	5
Extent to which product had to be modified resulting from user experience	NA	1	2	3	4	5
Extent to which product had to be modified to facilitate maintenance	NA	1	2	3	4	5
Ease of incorporating design/engineering changes	NA	1	2	3	4	5
Degree of success in meeting various deadlines	NA	1	2	3	4	5
Extent and seriousness of cost overruns	NA	1	2	3	4	5
Level of conflict of various groups at the transition from one major phase to another	NA	1	2	3	4	5
Extent of turnover of key people because of problems encountered during transition from one phase to another	NA	1	2	3	4	5

NA - Not (yet) applicable to this project
1 - One of our Star or Model projects
2 - One of our more successful projects
3 - Average project, nothing to distinguish it from any other
4 - Problematic project, but we somehow muddled through
5 - One of our worst experiences

The independent variables in the study fall into three categories: project, interpersonal and individual. The project level variables were:

- Radicalness of the technology which consisted of two subvariables — Newness of the technology and clarity of project goals; and
- Project salience consisting of two subvariables — Project's importance to the organization and project's importance to the departments.

Data on these variables were collected from project managers. The interpersonal variables were:

- Project specific politics; and
- Interpersonal dynamics which is an aggregate of Trust in team members, confidence in team members' technical capabilities, and project team cohesion.

The individual level variable used in this analysis was:

- Individual commitment to the project.

Data on the interpersonal and individual level variables were collected from project managers and others who had been associated with the focal project. For small projects we were able to collect data from all involved. For larger projects, the project manager identified selected individuals who had contrbuted most to the project, or had been associated longest with it. Each independent variable was aggregated to give a score for a project. This was done to take into account the variation in the number of respondents across projects and variables. While a certain amount of information can be lost by data aggregation, the advantages of this approach outweighed many of the shortcomings.

Two projects generated major disagreement between the gatekeepers and project managers. In at least one of them, this was probably because the former misunderstood the criteria for selecting projects to be studied. Consequently, the two were not included in our

discriminant analysis. There was also some further attrition in sample size, because the SPSS package used the "listwise deletion of missing data" option to run the statistical test. Therefore the number of projects finally included totalled 38, consisting of 15 problematic and 23 successful projects.

Table 2: Standardized Canonical Discriminant Function Coefficients for Independent Variables

Number of Cases : 38 Successful: 23 Problematic: 15

Canonical Correlation = 0.51 Wilkes Lambda = 0.74

Chi-squared = 10.46 p = 0.015

Technology Radicalness	– 0.37
Project Salience	—
Interpersonal Dynamics	—
Project Specific Politics	– 0.45
Individual Commitment	0.89
Group Means/Centroids	(0.47, – 0.72)

The results of the discriminant analysis are presented in table 2. The standardized canonical discriminant function coefficients for the stepwise analysis are tabulated for projects with nonmissing cases only. Only project specific politics, Radicalness of the project's technology and Individual commitment to the project, enter the equation; the first two with negative signs. Successful projects seem to be those in which organizational politics and radicalness of technology are low, and the individual commitment of project team members high.

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The magnitude of a standardized canonical discriminant function coefficient, without the signs, is the relative contribution of that variable in explaining the difference between successful and problematic projects. Our findings show that individual commitment of project team members is twice as likely as organizational politics, and nearly two and half times as likely as radicalness of a project's technology, to differentiate successful from problematic projects.

The "satisfaction" variable was analysed (table 1), to see which items differentiate successful projects from problematic ones. Since only nine of the 45 projects had data on this variable from production personnel, we decided to use the project managers' responses only. Therefore, for this discriminant analysis we had a total of 22 projects: 14 successful and 8 problematic. Results of the stepwise discriminant analysis showed that only three of the fourteen items entered the equation, with Canonical Correlation = 0.83, Wilkes' Lambda = 0.31 Chi-squared = 21.90, and p = 0.0001. The items differentiating successful from problematic projects with their standardized canonical discriminant function coefficients in parentheses were:

- Extent to which technical "bugs" affected production and upscaling (0.62)
- Extent to which product had to be modified to facilitate maintainance (0.45)
- Turnover of key people because of problems encountered during transition from one phase to another (0.35).

This indicates that, for "problematic" projects, difficulties hindering efforts to start and expand production or modify the product to facilitate maintenance were probably compounded by the turnover of key project personnel. Our discussions with project personnel indicated that technical issues, per se, did not clearly differentiate successful from problematic projects. Organizational and managerial issues appeared to play a role in aggravating any technological irritants. In the opinion of our respondents, some these issues included:

- Cutting project resources to unreasonable levels
- Organizational barriers such as several divisions or ourside vendors involved
- Lack of a clearly identifiable project manager
- Unrealistic schedules
- Lack of clear and consistent specifications and design details
- Resistance from sales
- Lack of in-house know-how, coupled with a reluctance to seek outside assistance.

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Recommendations & Management Implications

Levels of commitment of project team members to the project can be increased by:

- Making sure that a project manager is appointed who can effectively coordinate the activities of all the groups and individuals involved.
- Making sure that the project has reasonably clear-cut, yet flexible, goals and objectives.
- Assembling a team for the project with each individual having well-defined responsibilities.

Organizational politics can be lowered by:

- Involving all the individuals and groups that may be needed on a project as early as possible, preferably during the evaluation or selction phase of project formation.
- Getting all the involved groups to agree or at least concur with the goals and objectives of the project.
- Fostering an atmosphere on the project that does not unduly penalize individuals for making mistakes while taking calculated risks for completing or improving the project.

Despite the external factors influencing radicalness/newness of project technology, measures can be taken to "hasten slowly" by:

- Avoiding rushing technologically complex or totally new projects. The time and cost of firefighting subsequent technical problems and trying to "fix" a "broken" project, may be more than that of a less hasty approach of debugging the design and vetting it at each stage.
- Breaking up the project into several stages that can be done in parallel or sequence, particularly for every new or frontier technology.
- Bringing in manufacturing personnel as early as possible, preferably during the idea evaluation or project selection stage.
- Ensuring frequent interaction between R & D and Production personnel while the design is being finalized and the prototype is being fabricated.
- Giving team members and assigned downstream functions such as production, marketing, service, and engineering time to think through the design early in the life of the project.
- Introducing the results of the project onto the shop floor or market in well-planned stages, allowing for early debugging problems that might be anticipated or encountered.

There is a critical need for the management to understand the technology being developed by the company, from both the design/engineering and manufacturing perspectives. Managers should realize that technology rarely provides solutions. Rather, technology presents decision makers with a range of potential options to choose from, based on economic constraints, time and resource considerations, etc. Appreciating the potential limitations of any technology will enhance the quality of decisions, thereby avoiding difficulties at the R & D-Production interface, or, what is worse, fiascos after introducing the product onto the market.

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Lessons for Indian Companies

With the advent of economic liberalization, Indian companies have been presented with unprecedented opportunities, as well as unforseen threats posed by entry of multinational corporations. If Indian companies are to hold their own in the face of increased competition, they will have to become adept at designing new products based on indigenous capabilities. Before being seduced by new management practices like concurrent engineering, they have to put their house in order. Obviously, recommendations specific to the Indian scene have to wait until more research can be done on the factors influencing new product success and failure in local companies. Until then, the results of this paper identify some of issues that must be kept in mind. Failure to appreciate this could result in the continued failure to develop an indigenous technological base, or even the dramatic collapse of well known Indian companies when confronted by the MNCs and the brutal competitive realities of the new economic era.

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References

1. **Baker, N., et al.,** A Multivariate Analysis of Environmental, Organizational, and Process Variables in the Process of Organized Technological Innovation, Technical Summary II, University of Cinncinnati, Cinncinnati, OH, 1984.
2. **Bergen, S. A., R. Miyajima & C. P. McLaughlin**, The R & D/Production Interface in Four Developed Countries, R & D Management, 18(3), 1988.
3. **Booze, Allen, Hamilton**, New Products Management in the 80's, New York, Booze, Allen, Hamilton, 1982.
4. **Cooper, R. C.**, The Dimensions of Industrial New Product Success and Failure, Journal of Marketing, 43, 1979.
5. **Ginn, M. E.**, Key Organizational and Performance Factors Relating to the R & D/Production Interface, Unpublished Doctoral Dissertation, Northwestern University, Evanston, IL, 1983.
6. **Ginn, M. E., & A. H. Rubenstein**, The R & D/Production Interface: A Case Study of New Product Commercialization, Journal of Product Innovation Management, 3, 1986.
7. **Lilien G. L., & E. Yoon**, New Industrial Product Performance: A Strategic Reexamination of the Empirical Literature, IEEE Transactions on Engineering Management, EM-36, 1, 1989.
8. **Madique, M. A., & B. J. Zirger**, A study of Success and Failure in Product Innovation: A Case of the U. S. Electronics Industry, IEEE Transactions on Engineering Management, EM-31, 4, 1984.
9. **Myers, D. G., & S. Marquis**, Successful Industrial Innovations: A Study of Factors Underlying Innovation in Selected Firms, Washington, D. C., National Science Foundation, 1969 Publication No. NSF 69-17.
10. **Rothwell, R., et al.**, SAPPHO Updated — Project SAPPHO, Phase II, Research Policy, 3, 1974.
11. **Rubenstein, A. H., et al.**, Factors Influencing Success at the Project Level, Research Management, 19, 3, 1976.
12. **Souder, W. E., & V. Padmanabhan**, Transferring New Technologies from R & D to Manufacturing, Research-Technology Management, 32(5), September-October, 1989.
13. **Von Hippel, E.**, Successful and Failing Internal Corporate Ventures: An Empirical Analysis, Industrial Marketing Management, 6, 1977.
14. **Yoon, E., & G. L. Lilien**, New Industrial Product Performance: The Effects of Market Characteristics and Strategy, Journal of Product Innovation and Management, 3, 1985. □

'The organisation is a system with a logic of its own, the weight and tradition of inertia. The deck is stacked in favour of the tried and proven way of doing things and against the taking of risks and striking out in new directions.'

JOHN D. ROCKEFELLER