Active Intermediaries For Technology Development: The Korean Case

Hyung Sup Choi

The traditional Korean work ethics does not seem to apply to people who undertake research. Research management has a connotation of support and fostering rather than the traditional management role of control and governing. The inefficiencies encountered in the existing research organisations in Korea resulted from in part, a lack of autonomy on the part of the research staff. In these institutions, there existed constant external intervention and internal bureaucratic controls, which were the attempts by the external supervisory authorities and top management of the organisations to increase output; argues this paper.

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To attain technological development, a nation must decide on its strategic industries and select the required technologies for them. As these strategies are transformed into action, the results must be constantly checked and monitored against the nation's global economic development plans and against possible changes in national resources, because, an industrial development strategy is nothing but a subset of the global economic development plan of a nation, subject to resource availability. Generally, developing a strategic technology in developing countries denotes the assimilation and application of technologies which already exist, and are at times well known in developed countries, by implanting them into domestic industries. Because these technologies are time-proven and well established, developing countries can imbibe all the experience associated with these technologies.

Due to what is lately called "protectionism" or "nationalism" on the part of donor nations, or other reasons, transfers of certain key technologies are sometimes not feasible. Under these conditions, developing nations must find a way to develop them on their own. One of the more important and challenging jobs of a research institution is precisely in this category — they have to

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come up with the needed technologies independently or jointly with other institutions, within a prescribed time frame. Those technologies when completed and fully developed can be implanted into local industries. Indus-

trial research organisations are the major media for the technological development of a country, particularly, a developing country.

As an intermediary agent for technological development, an industrial research institution must have the requisite abilities and resources. Also it must possess an indomitable will for innovation and technical advance. Several national or public institutes for research, or testing labs in developing countries have unfortunately, been unable to fulfil their mission for lack of these means and qualities. Primarily, private industry should lead a country's technology development and carry out the missions given. In a developing economy, however, as is often the case, private industry is unable to do this and, the government has to volunteer support and funding. Two kinds of functions can be identified for the medium. The first function is as an industrial research and development institution and the second, encompasses standardization and quality control, analysis and dissemination of technological information, and so on.

R & D investment has been accepted for some time as having equal significance as other direct industrial investments, such as capital and facilities. But it is only in the last few decades that the perception of R&D investment as a major factor for the accomplishment of industrialization has become widespread. By understanding the true importance of R & D, one may evade some of the costly trials and errors that other countries

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have made in the process of development, while ultimately catching up with advanced nations by closing the technological gap. The first priority to this end is the setting up of technological development mediums directly linked to industry (Choi, 1986). These institutions, should clearly distinguish themselves from academic institutions. They must devote their entire capacities to technological and economic problems. They can proceed independently or according to requests made by government or industry. When an institution performs tasks on external requests, expenses may be estimated and settled by cost accounting. The two parties, the government or industry and the institution, should maintain a close relationship throughout the contract period and preferably thereafter.

Origin & Functions of Research Institutions

Historically the concept of an industrial research institution is fairly new. It had its origin only at the turn of the century. Industrial research institutes may address the following problems:

First, analysis, and transfer of advanced technologies from abroad to domestic industries. This is one activity which is indispensable particularly in developing countries, because they are highly dependent on technologies and skills developed elsewhere. Industrial research institutions must select and assimilate them to the fullest extent before implanting them. Generally, industries of developing countries do not fully absorb the technologies they use, nor keep up with changes in them. They simply carry out routine operations and maintenance of the plants. Consequently, they look for products to achieve higher productivity from outside, usually from foreign firms. Also when the plants run into problems, companies again seek help from abroad. This process tends to repeat itself. Technical problems, however, can and should be solved independently by the industry. Sometimes the problem is more complex, involving changes of raw materials from imports to local materials, product improvement to meet changes in consumer taste, etc. Industrial research institutes should be able to solve these problems. They should have been sensitized beforehand to potential problems.

Secondly, industrial research institutes function as a channel for introducing new technologies. A high dependency on imported technologies exists not only in developing countries, but also in developed countries, because, there is a need to upgrade the production technologies of existing processes.

A "channel" is instrumental in locating highly developed and appropriate technologies, and transferring these to wherever they are needed. An industrial research institute should be well capable of this function; it maintains many connections with various research institutions and their researchers and technicians throughout the world, it holds a wide range of technical, economic, and cultural information and is capable of comparing different alternatives for the appropriate choice of technologies to establish international exchange programmes in science and technology.

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Thirdly, industrial research institutes must be responsible for educating research personnel in order to utilize them effectively. A developing country, as a rule, is short of specialists. A research organization is an aggregation of experts and specialists, who are constantly updated and retrained in their own fields. These people are well equipped to solve industrial problems.

Fourth, an industrial research institute must cope with the nature of research problems. For example, if an industry encounters a special problem, it must hire highly trained and experienced specialists to solve it. When the problem is resolved, the industry has no choice but to fire them. This is not a reasonable arrangement for either the industry or the specialists. An industrial research institute can carry out the same tasks, and pull out of it without any "side effects". The institute can gain new techniques, insights and experience through such assignments. In other words, this medium will act as a pool of expertise to help industry.

Fifth, a research institute gives significant benefits to scientists and engineers by providing them with practical and professional research experience. For instance, for a young scientist or engineer fresh out of university, an institute is an excellent place to gain real-life experience and training in dealing with actual industrial problems. Also it may provide opportunities for him to get additional training overseas, in a quite different industrial environment.

Lastly, an innovative management system should be set up by which creative people and other necessary resources are selected, organized and integrated to achieve the goals of a national industrial research organization (United Nations, 1966).

Approaches to Industrial Research

In the 1960's, Korea started a serious effort to rectify the vicious cycle of social and economic impasse towards economic self-sufficiency. To this end, the government established a series of Five Year Economic Development Plans, the first of which was launched in 1962. The theme of the Plans was modernization of the nation by industrial development and the implementation of these plans resulted in the unprecedented economic growth of Korea. Top priority was given to increased exports of manufactured goods. The plans thus necessitated the use of a number of process skills and manufacturing technologies to generate the high volume of industrial production. However, in those years the level of industrial technology available domestically was too low to be efficient in producing export goods. Obviously, what was needed then was a prompt import of key technologies, followed by their adaptation and improvement to suit Korean conditions. Also needed were the infrastructure and support systems that would enable those industrial activities to proceed effectively. Evidently, one of the supporting means called for was industrial research and development institutions.

In Korea, in the early 1960's, there were a few testing laboratories and research institutes. Most of these were national or public organizations. Their main concerns were administrative support for the ministries or government agencies concerned with testing, analysis, inspection, certification, etc. There also existed a few university-affiliated research centres, but they served better as organs of instructional support for science and engineering education than as research institutes carrying out practical research and development. Nor had private industry accumulated technologies of material value. Their chief concerns were simple analysis, testing and inspection of products and some quality control needed in manufacturing processes. Under these circumstances, the idea for instituting a full-fledged industrial research organization was a viable strategy.

In May 1966, during summit talks, President Park and President Johnson agreed on the establishment of a multidisciplinary industrial research institute to facilitate Korea's industrial development. This led to the foundation of the Korea Institute of Science and Technology (KIST) which came into full operation in 1969. The planning of this new research institute was based on three basic principles : autonomy, stability and research ambience.

The traditional Korean work ethics does not seem to apply to people who do research, best described as 'knowledge workers'. Research is a creative activity carried out by dedicated people with special knowledge and experience in a field. Because research is creative, unlike manufacturing or other routine activities, it is best achieved when people are left alone and allowed to do things the way they see appropriate. Intervention and control, whether internal or external, can seriously inhibit or even totally stifle the process of creation. Research

management has a connotation of support and fostering rather than the traditional management role of control and governing. In hindsight, one can now recognize that the inefficiencies encountered in the existing research organizations in Korea resulted from, in part, a lack of autonomy on the part of research staff. In these institutions there existed constant external intervention and internal bureaucratic controls, which were the results of attempts by the external supervisory authorities and top management of the organizations to increase output.

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Stability in a research organization refers to a long-term guarantee of financial stability of the institution as well as the security of the researchers' livelihood and welfare. Under the current circumstances, many research institutions in Korea including KIST cannot support themselves solely on external contracts. In the 1960's, the industrial community in Korea did not feel the need to ask research institutes for technical help. Conversely, research institutes had not accumulated enough experience and expertise to extend services to industries. In particular, large-scale, high-risk, and long-term development programmes required large sums of money on a continuing basis in order to achieve their intended objectives and at the same time maintain operational stability of the work force. Therefore, while the idea of operational self-sufficiency in the foreseeable future had not been overlooked, in the early stages, substantial financial support by the government appeared necessary.

Creating an ambience agreeable to research staff and 'knowledge workers' in general was considered a critical success factor. The past experience of successful research organizations demonstrates that in order to obtain high research output, an adequate physical environment and a free intellectual atmosphere with social recognition are prerequisites. This means appropriate physical facilities, and a creative and challenging work environment metaphysically.

Another important facet in organizing the Korea Institute of Science and Technology was the transfer of research results to commercial industry. With this in mind, plans were drawn up with built-in provisions to facilitate contractual arrangements with prospective clients for development work or other technical activities.

In order to formulate basic guidelines for the operation of the Korea Institute of Science and Technology, planners looked into case histories of a number of successful research institutes, including the Battelle Memorial Institute in the U.S.A., the National Research Council of Canada, the Commonwealth Scientific and Industrial Research Organization of Australia, the Max Plank Gesellschaft of Germany, and the Research for Physics and Chemistry of Japan. These and other studies yielded the following set of basic guide lines for the operation of the organization:

To develop and accumulate science and technology as a means for the development of the nation;

To seek balanced advancement of industrial research for the nation's industrial growth with basic research oriented to feed the former;

To maintain a close relationship with industry in order to promote transfer of the Institute research output;

To promote exchange of information and technical cooperation with research institutes as well as academic institutions in the country and abroad;

To secure adequate research facilities so as to give researchers an impetus to perform their research and development work with ambition and freedom;

To establish a sponsored contract research system based on accurate cost accounting to gauge inputs against performance; and

To employ able research personnel matched to the research tasks on a contractual basis.

Prioritization of areas of focus for research was based on the techno-economic surveys and assessment of the actual state of the industry in Korea at the time. A team of experts made up of Korean nationals selected from the industrial, academic and public sectors and those from the Battelle Memorial Institute had made extensive field surveys of 25 different industrial sectors over a period of 10 months. The team recommended that six of the areas it had investigated should be given high priority, demanding large-scale, long-term research and development. They were : materials and metallurgical engineering, food technology, chemistry

and chemical engineering, electronics, mechanical engineering, and industrial economics and management. Research personnel for the six areas of emphasis were recruited, and technical support, such as machine shops for in-house fabrication and repair of research equipment and tools, setting up a modern science and technology library, computer center, and organization of a group for the analysis of technical data and information, was provided.

Pay standards which were exceptionally favourable and other employment regulations were established for the research staff. Housing was provided for them free of charge. A system was set up to provide senior researchers with one year's paid sabbatical leave after three years' service at the institute, encouraging them to make use of it at well-established research institutes abroad, such as Battelle Memorial Institute in the USA. In fact, this was part of a more comprehensive plan for forming sisterhood relations with some of the more prominent research organizations abroad, whereby exchange of researchers, joint research programmes, and technical assistance could be made possible. In establishing these measures, planners constantly bore in mind two important things : first, how to keep the concentration of researchers presently at the institute on research problems without them having to worry about the welfare of their families, and second, to lure and invite better researchers from abroad in the future.

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In the meantime, a self-perpetuating board of trustees responsible for important policy and financial matters of the institute was formed. Prominent and responsible individuals were invited to the board from various governmental, industrial and academic institutions.

To provide legal bases for this and other similar institutions on a permanent basis the KIST Assistance Act was promulgated in 1966. The law stipulated that the institute was guaranteed the capital expenditures of construction and operation, an endowment fund, and in addition, an allotment of state-owned assets for the initial installation of the institute. Further, the law had provisions to preclude complicated and time-consuming administrative processes such as the prior approval of research projects and audits by the government after their completion. The operational endowment and income from its interest could be used by the institute for working expenses and all research and development work commissioned to the institute would be in contract form, whether from public institution, such as the government, or from private ones. When private industries commission KIST to carry out a certain development task, they are, by this law, entitled to total tax exemption on the entire contract amount.

The rationale behind the indispensability of a formal contract between KIST and its clients was, firstly, to encourage the industries to get actively involved during the course of the project and, secondly, to emphasize to the people who take charge of the project their responsibilities when agreeing to deliver to a client a product, process or service which is of practical and commercial value. In the absence of a clearly defined, mutually agreed objective, the researchers could at times conduct their research to satisfy their own scientific and intellectual curiosities, rather than seeking practical solutions to the problems industries face. Conversely, industries may not ask a research institute to solve their problems if the institute is not geared to that purpose. Even if the institute were given the research contract, industries may be less serious or even indifferent to the research results, or would be passive in applying the results to their problems. A formal contractual agreement for a research problem not only works in favour of the institute financially, but also creates a sense of 'participation and responsibility' between the institute and the client, leading to high R & D efficiency in terms of output generated for the resources put in.

Since its inception in 1966, KIST has undergone a number of organizational changes, both small and large. However, there have been no major modifications in either the basic features of the structure, or the organizational concepts. The board of trustees is the highest decision-making organ of the institute, deliberating such important policy matters as the annual budget and settlement of accounts, operational plans, and the acquisition and sale of important assets. Operation of the institute falls under the authority and responsibility of the President, who represents and acts for the institute.

The selection of research topics and researchers responsible for performing given tasks, the allocation of the budget for a particular research project, and other associated matters of importance are discussed at the Deliberation Council for Research.

Case Analysis of R&D Activities

The Korea Institute of Science and Technology (KIST) began its normal research activities in 1969, although it was established in 1966. Three years were spent to complete the preparatory work including construction, installation of necessary equipment and facilities, and the recruitment of research staff, etc. The institute's objectives are to render technological services to industries and to develop new industrial technologies which the country can utilize in its economic development.

In its early stages from 1967 through 1970, KIST concentrated on short-term projects in fields such as technical services, troubleshooting in manufacturing plants, and the selection, digestion and adaptation of imported technologies. Since 1971, its scope has expanded to cover not only bench-scale laboratory work, but also development research and pilot-plant testing for the commercialization of research results. In many cases, results have already been, or are, in the process of being transferred to industrial firms. KIST is also assuming the role of a national brain for the effective formulation of industrial development policy (Choi, 1984).

To sum up, KIST's successful operation stands as testimony that a systematic use of all available capabilities and resources in an organized form is an indispensable factor in achieving the successful industrialization of a developing country.

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It is frequently assumed that industrial research means only applied research, generating accusations from scientific communities that insufficient emphasis is placed on basic research. The problem has stemmed from, among other causes, industrial researchers' own lack of understanding of the scope of and potential for accommodating basic research as a part of their exercises. In fact, without such an understanding and without such an approach, industrial research itself might well be seriously hampered. Our experience convinces us that industrial research should indeed encompass basic research as a distinctive element in the whole exercise, and that it will in its turn contribute meaningfully to the applied objectives. "Applied objectives" is the key to opening the industrial research door to oriented basic research.

I shall draw on two Korean examples with which I am familiar : the development of liquid crystal display technology and the development of a manganese-base super alloy (Choi, 1975). Until 1970, little was made public concerning the chemical formula of the room temperature pneumatic liquid crystal compounds, despite extensive research in many laboratories which were in search of a new display means for the rapidly growing electronics industry. Two research groups at KIST--one in organic synthesis and the other in physics—decided to undertake coordinated, interdisciplinary research on the development of new pneumatic liquid crystals at the instance of an electronics group. A new method of synthesizing methoxy benzylidine butyl aniline (MBBA), which conflicted with one of the existing patents, has as a result been developed, and in fact two new patents were taken out—one for synthesizing MBBA and the other for an electrode etching process. In addition to attaining the applied objectives, this exercise proved eminently successful in achieving new knowledge the successful application of which led to the production of a display device mounted on a successful export item, an electronic digital watch.

The other case in point concerns a high heat resistant alloy. In view of the expanding industry's ever increasing demand for such a material in the manufacture of valves, nozzles, heat exchangers and so on, it was considered appropriate to develop such an alloy using a locally available material in place of the conventionally used nickel base, which had to be imported. The research was carried out with striking success and led to bench scale production of a manganese-base super alloy.

To substitute one element for another in a process—manganese for nickel in this case—it was necessary first to learn a great deal more about the nickel base super alloy itself. In the process, fundamental studies about the mechanism of age hardening, deformation characteristics, and so forth produced several scientific findings on metal physics, one of which earned its author his doctoral degree; but more importantly, the investigation led to a new technology which was then transferred to a production plant.

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integral part of such research. As a rule of thumb, the Korea Institute of Science and Technology allows up to 30 per cent of its total research volume for this purpose.

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Commercialization of R&D Results

KIST has undertaken numerous projects under contracts to industry. The level of industrial contract research has been maintained at about 60 per cent. The remainder of KIST's work is divided between government sponsored research, which is available to the public, and in-house research, funded through the interest accrued from an endowment fund. The latter funds were used mostly as seed money to test out some earlier ideas of KIST researchers. Over the years, the results of this work have accumulated so that KIST decided to establish an agency for "research commercialization" called the Korea Technology Advancement Corporation (K-TAC).

There are many articles about strategies to be employed for the successful commercialization of research results. Most of these, however, discuss situations encountered in an industrial environment where continuous feedback and contact with real world markets are constantly maintained. From the beginning, research projects are launched with commercial applications in mind.

As explained earlier, KIST at its initial stage of operation, forced its researchers to interact with industry by adopting the mode of contract research. From 1977 however, the Ministry of Science and Technology (MOST) launched a matching fund system to advance the required R&D funds to industry. Through this system industry was able to receive loans of up to 70 per cent of the project requirement, payable within five years following the project's commercialization. The fund had a profound effect on linking public research institutes with industry, since MOST awards the bulk of the fund to projects co-submitted by industries and research institutes under MOST coordination. The potential for commercialization was built into this matching fund award system.

In addition to this, MOST also provides funds for national projects that are essentially long-range in nature. These national projects are intended to solve problems that are common to some specific industrial sectors but which industry itself is often reluctant to solve alone. The institutes also undertake seed projects and in-house research, to test new ideas by researchers. K-TAC regularly reviews the results of national projects as well as in-house research, for potential leads for new business development. Once the initial review uncovers a potential area, the next stage is to conduct a prefeasibility study, where the market survey is the central issue. This is often time consuming, but is most essential. Approximately one quarter of the projects survive this phase. This is followed by a more detailed analysis where such items as initial capital investment and internal rate of return are estimated. Further attrition occurs and only about 10 per cent of the original number survive for further pursuit.

It is at about this time that K-TAC begins the earnest search for a business partner to take on the bulk of the work that remains ahead. This will either be a company or an entrepreneur, but the partner should preferably have manufacturing or sales experience. The location of a competent partner is probably the most important factor in making the project a success. Once the business partner is decided, K-TAC together with the partner, reviews the feasibility study in detail. At this stage, the partners also draft and sign such documents as a joint venture agreement, a technology licensing agreement, and articles of incorporation into the new company. All details are examined carefully, including the methods and valuation of stock. If this is not clearly agreed, it will almost certainly become a problem in the future, when K-TAC decides to sell its share to the partner. Finance of the project must also be discussed in detail. Normally, it is desirable for a new company to borrow only about half of the total investment required. In case K-TAC plans to consider the research result as a part of the equity, it is at this time that both the partners should agree on the monetary value of the know-how or patents, generated through the research.

Should it decide to do so, K-TAC can also invite development banks to take part in the venture. K-TAC's experience with development banks has been very good, as exemplified by the participation of the Korea Long Term Bank with K-TAC on a number of occasions.

In this age of technological revolution, the survival and growth of any new venture depends heavily on the company's ability to absorb new technology. For every one of K-TAC's successes, KIST has continued to

support companies with second and third generation technology to keep up with technological advancement.

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Guidelines for Further Development

Technology transfer cannot be said to be fully implemented until the technology has been made indigenous and "regenerative", through complete digestion and absorption. After World War II, Japan acquired technological innovations from abroad. However, little can be expected from imported technology without the capability to modify and improve it for domestic applications. Only after such modification is the development of a new improved technology possible. This signifies a break from technological dependence. One cannot emphasize the fact too much that this was the crucial factor that led Japan to its fantastic success of today (Mukaibo et al, 1966).

For the time being, Korea obviously cannot compete with the advanced countries for the development of original technologies. This requires the accumulation of sophisticated base technologies and considerable research investment, which enable digestion and application of the latest technologies developed elsewhere. Domestic R&D is a prerequisite for the sound selection, efficient assimilation, and fruitful adaptation of foreign technologies. Priority must be given to the sound and efficient utilization of available foreign technologies, and one must avoid engaging blindly in such noble but certainly financially unrewarding exercises as reinventing the wheel. Thus, for Korea, it is more advantageous to plan a gradual switch over to technological independence via a stage of absorption and upgrading; in other words, by relocating investments in favour of the digestion and improvement of imported technologies.

The success or failure of technology transfer, which strongly influences a nation's technological development, solely depends on the accumulated level of technology of a nation. The higher the technological level of the nation, the better judge the nation will be for the assessment and selection of proper technologies. And thus the process of digestion and absorption can be shortened (Mansfield, 1968).

One may recall again that Japan adopted a bold liberalization policy and concentrated, with equal emphasis, on the grade-up of scientific and technological capability through such complementary measures as: i) expanding R & D investment, ii) strengthening the cooperative research between academia and industry and iii) securing sufficient numbers of qualified scientists, engineers and technicians. A developing country like Korea must also construct an efficient national system of technology development through positive R&D investment, particularly through the promotion of in-house research activities in the private sector, the training and efficient use of scientific and technical personnel, policies on financial and fiscal incentives for research and development and an effective mechanism to diffuse imported or developed technologies throughout domestic enterprises.

In addition, the country has to pay great attention to future-oriented problems. These long-range problems obviously cannot be undertaken by a few individuals or institutions. Concerted, organized and systematic efforts are demanded. Since the solutions to these future-oriented problems require long lead times, investment and preparation must be made as early and promptly as possible. Determining priorities among tasks must be done with long range global goals in mind.

As developing countries expand their economic and technological capacities, advanced countries are expected to take defensive and protectionist measures. Therefore, with increased scientific and technological capabilities, one must pay greater attention to the following : first, one should be prepared to share technologies with others on a "give and take" basis in order to acquire necessary new technologies. Second, one should develop new products and processes based on the absorption and improvement of imported technologies and by a combination of the former with internal developments. This will permit a nation to detour or break through export restriction measures. Third, instead of importing ready-made technologies, one should import

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technologies which are still under development, or under application study, and then complete the development inside the country for one's own application. And lastly, basic research should be supported on a national scale to enable technical innovation. This is a process whereby one can evolve from a stage of imitation to one of creation.

Another strong point of KIST is to demonstrate that systematically well-organized capacity opens up vistas for applying indigenous potential to technological development. In the past, Korea could not afford to dream of mounting challenges in advanced technology and thus had to resort to the blind importation fo foreign technology. The cases of the new type of electronic switching system, the synthesis of pulp-like aramid fiber, the heat-resistant super alloy etc. developed by KIST in cooperation with industry, willl serve as reminders. An objective assessment of the extensive direct and indirect effects of KIST in and out of the country reveals that it played an important part in building a secure foundation for national development and industrialization, and KIST will continue to be dependent upon.

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Concluding remarks

There is no word that can more simply represent the economic development of a less developed country than "industrialization". Indeed, planners in many developing countries have taken industrialization actually to mean "economic development". Less significance has, however, been placed upon the need for technology development through industrial research in countries where industrialization has been chosen as the economy's prime mover.

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Industrial research in developing countries is not only a feasible proposition but also an essential endeavor to help realize industrialization goals within the context of regional and global economics. In addition, industrial research, if properly carried out, can help in setting reasonable and feasible goals.

Industrial research can be extremely useful in developing technological rapport with changing patterns of industrial development and it can, over time, act as a catalyst to change the attitudes of entities within the domain of industrial researchers, to enable them to cope with ever changing situations. In this regard, industrial research organizations might be considered as major intermediaries necessary for the technological development of a country, particularly a developing country. Sustained economic development in many developing countries totally depends on how soon, how much, and what kinds of industrial research they can manage to undertake.

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Feature

Role of Standards In Technology Management

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The developed world has realized long ago that standardization is a vital factor in the management of technology. This article examines the many facets of the key role played by standardization in real life industrial situations. The origin and development of the subject have been discussed in detail alongwith the implications due to the impact of rapid technological development.

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Management of technology encompasses many aspects—generation of technology, its dissemination and absorption, acquisition and formal transfer, innovation etc. In all these phases, standardization plays a vital role. Standardization is the process of consolidating the knowledge and experience at any given point of time and documenting the same for wide application. It is based on consensus of the diverse interests involved in the subject being standardized. The consensus management determines the extent of applicability and acceptability of standards. That is how organized standardization which started at the company level came to be practised at industry, association, national, regional and international levels with a view to manage as wide a consensus as possible to promote trade.

Standardization for Technology Development

The role of standards is better known in cost reduction than in development of technology. For years, practising professionals, particularly standards engineers the world over have stressed the cost and productivity aspects of standardization. Initial emphasis for standardization was on increasing productivity, interchangeability and the like. Later, standardization techniques were employed to promote safety, health, environmental protection etc. Early days' promotional literature that emanated from national standards organizations laid more emphasis on the cost benefits in adopting a standard, perhaps attuned to the needs of the time: reduction of varieties and waste. When the focus shifted towards the impending race for technological supremacy of one nation over another, the emphasis also shifted to development of new technologies at the lowest possible cost; and in the shortest possible time. Hence the increasing use of standardization to accelerate the pace of technological development.

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Further, quick and maximum exploitation of sophisticated technologies became necessary in view of the huge investments required for their development associated with high rate of obsolescence. Realizing this the emphasis is shifting to codification of technologies and standardization.

Origin & Development of Standards

Organized standardization activity first started with the primary objective of increasing productivity. Dimensions and tolerancing to ensure interchangeability of components led to introduction of mass production techniques. Today's mass production of automobiles as an assembly operation using components and parts manufactured by several hundreds of companies located in many countries would not have been possible but for standardization.

When trade was localized, standardization efforts were also localized. With the expansion of trade, it was necessary to cross geographical and technological boundaries. Thus there was an urgent necessity for harmonization of standards adopted by companies producing similar products or using similar raw materials or components. This led to the development of standards by industry or trade associations and professional bodies. National standardization also got the impetus out of this need.

With globalization of trade, standards also assumed an international character projecting the need for worldwide harmonization on various technical and related issues. Thus organizations at the international level with exclusive responsibility for standardization like the International Organization for Standardization (ISO), International Telecommunication Union (ITU) and International Electrotechnical Commission (IEC) gained prominence.

Standards are developed through a process of consensus; a procedure that involves getting the needed experts together to discuss and agree on solutions to recurring technical problems. This activity is often sponsored by governments and supported by industry and users. In India, the largest single organization at the national level attending to the task of establishing national standards is the Bureau of Indian Standards (BIS) which has prepared over 16000 standards today in various disciplines.

Since standards are documents (solutions in written form) consisting of rules and requirements, which in a way cover a part of technology which can be "codified", these have come about to be recognized as "trade facilitators" and often as "regulators of quality" provided nations agree on common standards to follow. Industrial cooperation at national, regional and international level view standardization from this perspective. The substantial efforts devoted to the standardization process at company, association and national levels is *per se* good, but standardization at international level has paved the way for technology becoming truly international. About 90 countries now participate in the efforts of the ISO and IEC and adopt willingly the fruits of their collective contributions in the national level work. Today it would be very difficult to associate the development of any technology with any single country. It is in this context that standardization helps technological development. Large industrialized nations participate actively in the development of these international standards, adopt them as national standards, while a large majority of developing nations with diversified technology base (indigenous, adapted and imported) use international standards as their starting point. The standards developed thus are described as technically compatible with international standards, further hastening the process of technological development globally.

With globalization of trade, standards also assumed an international character projecting the need for worldwide harmonization on various technical and related issues.

Role of Standards in Everyday Life

A number of examples can be cited in products we use in everyday life to illustrate the role of standards in technology development. The nuts and bolts we use commonly known as fasteners and their universal application came about through the establishment of standard solutions to profile dimensioning, limits and fits and engineering tolerances. The standards relating to screw threads is over a century old. It is such a common place

item today that it would be difficult to imagine that much debate and dissension preceded its acceptance. The development of the modern day cassette tape used in tape recorders and two-in ones and the universal standard for recording, play-back speeds facilitated entertainment for the millions. Nobody needs any change in these standard solutions which had aided technology development and assimilation and refinement of the technology and innovation on new products. In other words, often most products need not be continuously reinvented or redesigned; the standard solutions for solving repetitive problems offer the best route for development of technology.

In power engineering, standardization and adoption of preferred current and voltage ratings alone had brought about so much savings of material, time and energy that it has become feasible to redeploy these on several aspects of electrotechnology where such efforts remain productive. An area where standardization has helped technology grow leaps and bounds is information technology. Starting from the invention of the transistor in the 1960s, the integrated digital circuits and the myriad products that go under the generic term of information technology equipment (computers, office machines), development has been possible only due to standard solutions on basic aspects. Most important of all, the standards, once established, help in validating technology by providing a means for verifying quality levels and a basis for further improvement.

Role of Standards in Technology Development

The role of standards in technology development in high tech areas can be seen from the example of advanced materials, information technology and biotechnology.

Advanced Materials : There is a continuous urge for development of new materials to reduce the dependence on conventional materials which are fast depleting and to meet exacting demands of high technology applications. The three main areas for advanced materials are:

- Light weight but strong materials for various applications including aircraft and transport vehicles,
- High temperature materials for improvement of efficiency,
- Materials for electronic components, solar photovoltaic cells, thin films and multiple layers for micro circuitry, etc.

There is a growing need for standardization of methods of test and evaluation of advanced materials to promote their practical and widespread use. This would also help in comparing test data on common basis by users and manufacturers. Standardization of technical terms and test methods is necessary for constructing a reliable data base to enhance the use of advanced materials in industry.

Standardization of technical terms and test methods is necessary for constructing a reliable data base.

In the past, standards for materials were developed after relevant technologies had materialized as new product in the market. In the advanced materials area, there is a need for pre-standardization to work as a strong promoter of technological development. For example, to facilitate research in support of improved standards for new and advanced materials, an international collaborative research programme involving the Summit Nations (Canada, France, Germany, Italy, Japan, UK and USA and the Commission of the European Communities) was launched some years ago. This project was known as VAMAS, the Versailles Project on Advanced Materials and Standards. Selected VAMAS technical projects include: wear test methods, surface chemical analysis, ceramics, high temperature materials, polymer blends, and material data banks. VAMAS is expected to create an impact in the standards making process relating to advanced materials. The TIFAC project on National Material Policy has highlighted the contribution of VAMAS and in turn triggered an effort by BIS to bring together leading organizations in India to review the role of standards in materials development in India.

Information Technology (IT): Information Technology is the science of collecting, storing, processing and transmitting information. Importance of IT and its utility are increasing because of reduction in cost of computing power made possible by micro electronics which has coincided with the application of digitalization. The result has been the convergence of electronics, computing technology and telecommunications resulting in the IT Revolution.

Standardization provides strength to the efforts of R&D and manufacture in the IT area. Standardization

helps R&D efforts to fit into the complex pattern of this high-tech field. Globalization of information and the IT industry necessitated the adoption of harmonized standards world over to ensure compatibility.

That standardization work at international level is leading the way is amply clear from the developments taking place in the Information Technology area. To quote from Dr. L.D. Eicher's, (Secretary General of ISO) speech at Tokyo in June 1987. "The proportion of ISO work in the information technology field has grown about 5 per cent to over 25 per cent (currently 40 percent) in the last 5 years. The paper work alone has grown at the rate of 55 per cent per annum". The Joint Technical Committee of the two apex bodies ISO and IEC on information processing systems JTC-1 has 18 active sub-committees, each of which require vigorous administrative support from their secretariats. One committee currently lists more than 100 meetings of IT experts and these meetings regularly involve more than 50 delegates representing 20 to 30 countries.

BIS has been pleading for the setting up of a fully equipped centre for standardization in Information Technology with active participation of Department of Electronics, Department of Telecommunication, other Government departments, involved in the use of Information Technology and the industry (active in both hardware and software). Such specific centres may be needed in other areas of rapid development in future.

The fear that standardization may inhibit technological growth and has no relevance in high-tech areas where obsolescence rate is quite high, is unfounded.

Bio-Technology: Bio-technology is a multi-disciplinary technology involving disciplines like biochemistry, genetics, microbiology, physiology, morphogenesis, information technology, etc. It involves exploiting biological systems for the production or improvement of goods. The requirement of standards in this fast growing area relates to materials for bio-technology, characterization and identification of biological systems, unit processes and their controls, environmental issues, biomass conversion, process validation and terminology.

The fear that standardization may inhibit technological growth and has no relevance in high-tech areas where obsolescence rate is quite high, is unfounded. On the other hand standardization is essential for organized growth in high-tech areas. Without standards, high technology would not be able to get commercialized to benefit the industry and consumers.

International Standards & Future Development

As more and more standardization effort gets concentrated at the international level, and more nations willingly adopt international standards in national work, what really happens is the finding of common ground for agreement on issues concerning technology and an attempt to codify technology. This, in fact provides the greatest impetus to the use of standards so developed in international trade. Technologies that do not result in a product or system confirming to international standards on safety, interchangeability, energy and material conservation cannot sell. If national level solutions are not compatible with these standards, the country may well be out of of the global market.

With such a key role in management of technology, standards bodies have to look carefully at future needs. Since 1986, the ISO/IEC have placed great emphasis on understanding and responding to the new needs of international standardization. They have set up two groups to assist them in this task—the ISO/IEC President's Advisory Board on Technological Trends and Ad hoc Group on Long Range Planning. During 1988/89, a global survey was carried out on the standardization needs especially for the emerging technologies. The results of ths survey have been remarkable and have been of help to technology policy makers and planners world over. The document 'A Vision for the Future' of the ISO/IEC brought out in 1990 presents an analysis and recommendations concerning standardization approaches for new technologies together with findings of a global survey on future standardization needs. In India, TIFAC has made good use of this input. The document needs a much wider dissemination to sensitize the Indian scientific and technical community.

Globalization has become a reality today. All but the smallest or the most local commercial and industrial enterprises are finding that their principal market place competitors include companies headquartered in other countries. Consequently, technology/product development must be done globally to reckon with global competition. The rapid implementation of the European Community's single market concept has also become a major driving force. Obviously, this places new pressures on India since we wish to trade with European companies and would like to compete with them in other

markets. The assurance that we have to provide on our technology to an overseas buyer necessitates our adoption of standards demanded by the new market players: particularly those governing certification systems. The four goals for Indian technology development are "Universal acceptance, current compatibility, forward compatibility and forward flexibility" in a highly volatile market situation. All investments on technological research must facilitate these goals. It is obvious that none of these goals can be achieved without standardization and appreciation of international standards in the relevant field.

The four goals for Indian technology development are "Universal acceptance, current compatibility, forward compatibility and forward flexibility".

In the case of technologies of the future the task is complex. The time, effort and cost to develop standards in such complex fields will be high and at the same time the standards may be rendered obsolete faster. There is, therefore, a need for increasing the dynamism in standardization. Professional bodies as well as industry and trade associations in India which hitherto did not attach significance to standards development and application aspects in their fields of activity should get involved and give the impetus needed for standardization to place India in the world technology map. The approach to standardization itself may require to undergo a change to cater to the advent of liberalized industrial policy. The main players in this exercise are not only the organizations involved in standardization like BIS but all organizations and individuals, public or private, engaged in diverse activities like supply of goods and services, administration, scientific and industrial research etc. Once this is understood and organizations learn to network, standards and standardization will play the role they ought to, in India also.

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Any society in the era of the new technology would perish miserably were it to attempt centralise responsibility and decision making at the top. It would go under as did thee great reptiles of Saurian age who attempted to control a huge body by a small centralised nervous system that could not adapt itself to the rapid change in the environment.

— Peter F. Drucker

Strategic Management of Technology: Major Decision-Making Issues

P.N. Rastogi

Management of technology by an industrial enterprise is bound with its business strategy. The latter governs the products a firm decides to produce and the technology it needs to use, acquire and develop for this purpose in the light of market competition. Major decision-making issues in this context relate to assessment, selection, acquisition, assimilation, use, integration, upgradation, incremental innovation, and development of existing and/or new technology. These issues are not however, independent or disparate. The basis of their formulation and resolution lie in a company's competitive business strategy on the one hand, and a strategic vision of its future on the other. This paper explains briefly some of the major decision issues associated with technology management in terms of this broad orientation, and outlines the new Japanese concept of 'technology fusion' for competing and excelling in world markets.

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Technology and its management are today matters of global primacy. Technology is being developed, improved, combined, refined, bought, sold, and traded around the world at unprecedented levels. To maintain their competitive edge, companies are increasingly looking outside. They adopt and assimilate new technology, improve and refine existing technology, and combine both in their quest for commercial success in world markets.

Companies adopt and assimilate new technology, improve and refine existing technology, and combine both in their quest for commercial success.

From semi-conductors to super computers, super conductivity to 'miracle' materials, jumbo jets to genetic engineering, technology has become the single most important factor driving the global competition. Technological development and innovation are engendering new businesses, transforming old ones, and redefining the rules of competitive success. Competitive success increasingly goes to enterprises that can absorb, apply, and coordinate new developments quickly.

Successful firms across the world's industrial spectrum are speeding up the commercialization of innovative ideas to meet specific business and customer needs. They are developing and using the tools and techniques, structures and processes, and the technological infrastructure to be more dynamic, productive, and innovative. Keeping a product-line competitive requires continuous, incremental improvements in function, cost, and quality. Cost-effective design, new process/product technologies, concurrent/simultaneous engineering,

flexible manufacturing systems, and high level of production engineering are most important in this context. Competitive success increasingly depends on the effective management of technology. It is therefore necessary to understand the nature and dimensions of technology management, and the decision issues pertaining to it.

Holistic Approach to Technology Management

The concept of technology in the present context needs to be comprehended in a holistic sense. Technology and its management cannot be narrowly viewed merely in terms of machines, equipment, instruments, and processes. Manufacturing technology comprises five inter-connected and inter-dependent facets. Each of these facets needs to be cognized explicitly both individually and in terms of its multilateral linkages with others, for the purpose of managing technology effectively. These facets are:

- Production Process(es): This facet includes design and layout of production facilities; type and mix of machines and equipment; flow of information, materials, and people; elements of automation; computer systems hardware; monitoring, control, maintenance, and simulation of operations and facilities.
- Product & Process Design: This facet is related with the design of products including materials, parts, components, and features, on the one hand, and design of processes and their interconnections with products, on the other. Both products and process(es) may be designed simultaneously in terms of 'concurrent engineering' towards achieving zero-defect production.
- Information Systems: This facet includes methods and systems for communication, integration, intelligence, production control and overall coordination.
- Orgaware Technology: This facet relates to organizational support system that facilitates the transformation process, including administration, communication, integration, coordination, learning, acquisition and retention of knowledge and information, and incentive/reward systems.
- Materials Technology: This facet relates to the knowledge and use of the properties and attributes of core materials, interconnection of parts, composites and functions.

Production/manufacturing technology, in the holistic sense, describes the way in which the foregoing five facets interact together to convert resources into outputs. The technology of a firm along any of these facets may or may not be innovative, new, state of the art, or advanced. Effective management of technology implies continuing improvement, consistency, and coordination of all the foregoing five facets. Decision-making issues in this context centre on how to bring about continuing and conjoint improvements in order to sustain and upgrade the company's distinctive competency, towards its potential competitive advantage. These decision issues together define the firm's technology strategy. The latter broadly refers to a company's planned vision for the modernization of its productive core, and its key interface and support functions like engineering, information, materials handling or logistics. Technology strategy also defines the nature and requirements of desired change(s) and the ability to implement that change.

Technology strategy refers to a company's planned vision for the modernization of its productive core, and its key interface and support functions

Technology Strategy

Technology strategy of a company is constituted by the following two basic elements:

The company's ability to perceive the need for change in its technology base. This perception is a part of the company's perception of its competitive environment.

The company's ability to implement the perceived requirements of change(s).

Technological changes in a company may in turn, involve one or more of the following:

- *Minor improvement* in the company's existing product or process technology,
- *Major enhancement* in an existing product technology,
- *Developing an entirely new core technology* that is integrated with an existing company technology in the final product i.e., *new, related technology,*

- Developing *a new, unrelated technology.*

The effective implementation of such changes, however, depends on the strength of an organization's culture (Rastogi, 1990, 1991). In this context, R&D and engineering cannot be separated from the core business decision-making by an enterprise. Without a strong culture of productivity, excellence, and innovation, acquisition and use of superior hardware by itself cannot generate a sustainable competitive advantage.

> "We have seen a number of companies that have been able to build a powerful competitive advantage around their internal capabilities and teamwork, even though their plants and equipment were not exceptional; but we have never seen one that was able to build a sustainable competitive advantage around superior hardware (technology) alone..... It is almost impossible for a company to "spend" its way out of competitive difficulty" (Hays, Wheelwright, & Clark, quoted by Erickson et al., 1990).

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For obtaining sustainable competitive benefits, continuous improvements in both structural and infrastructural elements need to be made in tandem, in a mutually supportive manner. The guiding impulse here is provided by the firm's business strategy.

Business Strategy & Technology Management

Five sets of questions are useful in systematically examining the relationship of a company's programme of managing technology to its business strategy (Erickson et al., 1990). They also highlight the decision-making issues. These sets of question are:

- Does the company have a clear product and market strategy? What markets does it want to enter? How? What markets does it intend to defend? What product and service attributes will accomplish these goals?
- What technologies support the product and market strategy? Which ones produce competitive advantage in existing markets by adding value or lowering cost? Which ones promise to support new market initiative, or to define a new level of product performance?
- What technological successes can the company support or exploit?
- Does the R&D programme focus on developing capabilities in technologies that will, or may, support its product and market strategy? Are options for technology acquisition (in-house development, licensing, academic support etc;) being examined in relation to the company's immediate product and market strategy as well as its future vision?
- Does the R&D staff have access to the firm's key customers? Do the R&D staff, manufacturing engineers, and marketing people work together to ensure that R&D ideas can be made into high quality, low cost products that will meet customers' needs?

The central task of technology management in a firm in the context of its business strategy is to assure that the firm gains and/or maintains a strong position in the technologies relevant to its product-market relationship, and that these technologies support the firm's competitive strategy. It would however, be erroneous to infer one way dependence of technology strategy and technology management on the firm's business strategy. Technology strategy also takes cognizance of emerging technological developments, that may engender new opportunities and threats for the firm. The firm's business strategy is expected to respond to these opportunities and threats. The interaction between a firm's business strategy and technology management is hence one of reciprocal influence. This interaction leads to regular review and revision of the strategic targets of the firm on the one hand, and the goals of its technology management programme, on the other. Such a review is governed by the requirements of consistency, balance, and mutual supportiveness between business strategy and technology management.

The central task of technology management in a firm in the context of its business strategy is to assure that the firm gains and/or maintains a strong position in the technologies relevant to its product-market relationship.

Management of technology encompasses continuing improvement in the five facets outlined earlier, as well as, the management of R & D in product(s) and/or process(es). Together, all these functions of technology management form a spectrum of the overall process of product creation. Japanese companies have demonstrated their superb ability to integrate all phases of the product creation process in a cost and time effective manner. Effective management of technology today is bound up with the efficient integration of all phases of the product creation process. It is subject to the principle of continuous improvement. An enterprise must have a technology road map for continuous improvement related to the strategic variables of its business.

Factors facilitating technology management

The most important overall factor underlying the effectiveness of an organization as a whole, is its culture (Peters & Waterman, 1982; Rastogi, 1988). However, certain more specific factors facilitating technology management, have also been identified empirically. Giffy et al (1990) term them as the "areas that have the greatest impact on success of technology implementation". These factors or `areas' may be outlined as follows):

Top Management's Viewpoint: Management views technology not as individual components but as part of a total system of resources and capabilities. Top management acknowledges and understands the vital linkages between process technology, product design, suppliers, manufacturing engineering, human resources, and the shop floor. It maintains responsibility for the fundamental soundness of technology decisions.

Nature of Technology Decisions: Technology development follows a path rather than discrete steps. CIM (Computer Integrated Manufacturing) for example, is a step in the organization's development of technology, not the achievement of a certain level of technological development. Every technology decision can and should have a strategic impact. Technology decisions are viewed as capability enhancing.

Every technology decision can and should have a strategic impact.

Focus of Technology Development: Technology development focuses on processes that are central to competitive advantage such as developing process technology internally. In areas that are not central to the company's plans for competitive advantage, the best off-the-shelf technology available is used. The organization must recognize that competitive advantage can be created through superior integration of purchased technology. Continual development and experimentation are encouraged to avoid initiating high risk, quantum leap projects to keep abreast with competitors. The focus here is on how the organization channels its vision of strategic advantage into technology development projects; how it decides where to expend resources, and how to obtain technology.

Technology Justification Process: It is based on the company's strategic understanding of the market place and its current market position. The response of competitors to specific technology investments by the firm is considered explicitly. The cost of not implementing a new technology is factored into the justification, and planning process. The costs of obsolescence and keeping abreast with competitors are considered. The planing horizon used for evaluating the appropriateness of investment is sufficiently long to reflect the technology lifecycle.

Implementation Process: The company fosters an atmosphere supportive of innovation; constant experimentation and piloting of new ideas are encouraged. Incentives reward innovation. Projects phase in the new technology, supporting both the learning process and the developmental migration path. Challenging goals are established for technology implementation projects. Multi-disciplinary teams are drawn from every area of the organization. The teams comprise the organization's brightest and most dedicated personnel.

Middle managers must be motivated towards accomplishing significant goals, and providing the fundamental energy that drives the advanced technology engine. Top management must ensure that the middle management team is prepared to act, not only in executing the vision, but also in expanding it.

The last factor or area specifically refers to organization culture as a system of shared values, beliefs, and vision. One viewpoint goes as far as to suggest that the basis of a company's culture lies in its production engineering. According to Fujita (1989, 1990), '*when a production engineer and a foreman resolve a problem in cooperation with workers* as practised in Japan, *the process fosters organizational fusion; recurrences of*

the process will gradually give form to a new culture'. According to him, production engineering not only constitutes the direct cause of creation of new culture through stabilization and enhancement of production, but because it represents an organized effort participated by employees, their day-to-day problem-solving exercises lead to "accumulated innovations". Thus, production engineering guarantees development of culture in the double sense. He concludes, "Creation of new culture is conditioned by the local level of production engineering".

Technology Decision-making

Renovation of the existing production facilities requires an assessment of the new technology to be acquired. Such an assessment proceeds in terms of the evaluation of economic feasibility, technical feasibility, operational feasibility, operational compatibility, and operational versalitity of the whole or parts of a technology package. A concept useful in charting the course of decision-making in this context is a three-axis descriptor of the characteristics of manufacturing (Ehner & Bax, 1987). The three axes may be outlined as:

- The X axis is the transformation axis and involves all the cutting, forming, painting, and other processes that change the condition of the material. This axis may be designated as the *maker.*
- The Y axis is the finalization axis and includes all materials handling, storage, and assembly activities. It can be viewed as the *mover.*
- The Z axis includes all test and inspection activities, data-gathering operations, and production control, inventory control, and cost control activities. It is the information axis. This axis may be thought of as the *timer* because it sets the speed with which the axis can flow through.

The three axes are interrelated but trade offs between Y and Z are possible, allowing different ways of reaching the same level of efficiency and productivity. Only the X processes add to product value. The remaining Y processes and all of the Z processes contribute nothing to product value. They, however, contribute to the speed with which parts move through the factory. The task of technology management in this perspective is to design and organize a production system in terms of an optimum combination of the three axes. Such a task may require different axis positions for each plant or factory.

Single Core Technology Vs. Plural Technologies

Deciding what products to make, and how to make them, is a continual decision-making challenge for technology management in companies. The decision issue here focuses on whether a firm should have a single core technology or pursue technical diversity. Evidence from USA and Canada indicates that companies that focus their new products on extensions to a single key core technology are far more successful than those who do not follow such a course of decision and action. Successful Japanese companies however, do not concur with such an inference. In USA and Canada, companies that concentrate on the internal development of a single technology, or a closely related set of technologies, and focus on related market applications, achieve both technological product excellence, and a deep understanding of their customers. Without a defensible core technology, the technological venture cannot assume a leadership role in its target markets. In contrast, companies that develop a strong core technology, show the ability to develop new products faster, with greater reliability and quality, than unfocused companies (Roberts, 1991).

Deciding what products to make, and how to make them, is a continual decision-making challenge for technology management

The best opportunities for rapid growth of a young firm come from building an internal *critical mass of engineering talent in a focused technological area, yielding a distinctive core technology that might evolve over time, to provide a foundation for the company's product development.* These products should be targeted at a focused set of customer needs. Successful high technology firms in Japan however, follow a rather different approach in this context. They pursue technological self-sufficiency, and for this purpose proceed towards mastering the relevant subtechnologies also. American firms leave subtechnology(ies) specialization to their suppliers. They assess a new technology in terms of the risks of adopting it, and their research is focused towards narrow, specific, and limited applications. *The Japanese companies by contrast, assess a new technology in terms of their potential vulnerability, if they fail to adopt it. They approach R&D from the viewpoint of multiple applications and the creation of technological capabili-*

ties from a relatively long-term perspective. This approach has led them to evolve a new concept of technological innovation—'technology fusion'. The latter refers to development of new hybrid technologies by combining the technological capabilities of existing technologies.

Competing By 'Technology Fusion'

'Technology fusion' refers to R & D focus on combining existing technologies into a hybrid technology. 'It blends incremental technical improvements from several previously separate fields of technology to create products that revolutionize markets' (Kodama, 1992). Such 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 ('methatronics;), Fanuc created an affordable numerical controller and became a market leader.

Successful companies today are not necessarily those that create new technologies, but those that rapidly absorb them.

Dynamics of technology fusion render established technologies in any industry susceptible to displacement by radically different technologies coming from outside. In effect, the critical resource for competitive manufacturing today is not capital and labour. Successful companies today are not necessarily those that create new technologies, but those that rapidly *absorb* them (Branscomb, 1992). This requires an organizational capacity to identify promising new technologies worldwide, and absorb them into new products and processes, quickly and effectively.

A company's capacity to absorb and adopt technology is increasingly becoming the key to business strategy (Kodama, 1991), As mature markets become saturated, Japanese companies are using their ability to apply new technologies to specific business needs to shift into new and more profitable markets. Canon, for example, has moved from cameras into office equipment such as laser printers and fascimile machines. NEC has moved beyond its original base in public telecommunications switching and transmission equipment to main frame computers, semi-conductors, and more recently to mobile telephones and laptop computers (Branscomb, 1992).

Emerging Technologies

Another major decision-making issue associated with a firm's technology strategy and management relates to the formulation of its stance and position with reference to areas of emerging technologies. An 'emerging technology' is defined as one in which research has progressed far enough to indicate a high probability of technical success for new products and applications that might have substantial markets within ten years. In consultation with private industry, the Technology Administration of US Commerce Department (1990) identified 12 'emerging technologies' as among those most applicable to commercial opportunities, lying in the following four areas:

* Advanced materials such as ceramics, polymer composites, metal alloys, and superconductors.
* Electronics and information systems, including advanced semi-conductor devices, digital imaging technology, high-density data storage, high performance computing, and optoelectronics.
* Manufacturing systems, including artificial intelligence, flexible computer-integrated manufacturing, and sensor technology.
* Life sciences applications, including biotechnology and medical devices and diagnostics.

A firm has to decide whether or not to enter into any of the foregoing areas, and if so in what manner, and when.

Conclusion

The complexity of technology management is exceeded only by its importance. It represents the cutting edge of a firm's business strategy. It involves a multitude of decision issues which interface with every major area of enterprise management. These issues are related to perceived needs, opportunities, threats, impacts, strengths, weaknesses, and key concerns of a firm in relation to ongoing developments in technology and markets. Firms need to be constantly on the lookout for emerging developments in both technologies and markets. They need to be oriented towards improving their critical competencies or capabilities toward absorbing

new technologies, and improving and, combining existing technologies. They need to be productive towards seizing new technological opportunities and facing new market challenges. Finally, they need to know far more than they do now about what is happening in laboratories around the world.

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***A Formula for Handling People in Business*:**

- Understand what the other man wants to accomplish.
- Give each of your subordinates the feeling that you have a deep personal interest in his work.
- Put each man in business for himself. A man produces best when he is responsible for a specific result, whether it be the finishing of a tiny part or the directing of a great factory.
- Don't judge employees on their attitudes, but on their production. There is no reason to assume that a sweet-tempered worker is a better investment than an habitual grouch.
- Create an atmosphere conducive to originality and free expression of ideas.

Source : Charles A Cerami : How to Solve Management Problems, Englewood, Prentice Hall

It is necessary to evolve criteria such as efficiency and productivity on true scientific lines so that identification of viable technologies can be made.

Regulation

In the framework that is emerging in India's economy where Governmental controls are being removed in respect of inflows and outflows of capital, technologies, and products it is necessary to evolve an alternative mechanism for regulation of these inflows and outflows. Since technologies tend to entrench themselves deep into economies, and thereby obstruct or preclude subsequent technological choices, it is necessary to evolve a national Technology Selection Policy to influence and regulate the flow of technologies in India.

Adaptation

Hitherto adaptation of foreign technologies into India has been little more than "ruggedisation" of the imported technologies or ancillarisation of sub-components and sub-assemblies, all of which passes under the name of Technology Transfer. Instead, adaptation should be in the nature of Technology Transplantation starting from the stage of design and detailed engineering itself, and go on to replication of improved prototypes, indigenous development of dies and moulds and indigenisation of measuring and calibrating instruments connected with the technology.

Legislative/Accountancy Framework

Our laws such as the Companies Act, Income Tax Act, etc., still retain a 19th century European outlook. It is necessary that these laws be comprehensively recast so that the true costs and benefits of industrial enterprises employing technologies are reflected in their profit and loss accounts and balance sheets. Corresponding to the legislative changes necessary, the concepts and practices of national-level and firm-level accountancy also need to be revised.

Technological Education System

It should be a question of profound interest to the philosophers and analysts of scientific history as to how even the scientific section of the university academic system of the world could ignore its own fundamental presuppositions regarding technology; particularly the academic system in the third world which had direct access to the effects of the hidden/externalised costs of technology. The syllabi, teaching-methods, and examination systems prevalent in India's universities, institutes, and research centres of technology need to be thoroughly modernised so that the coming generations of academic scholars and engineers will work in the more scientific, binary worldview of technology.

The syllabi, teaching-methods, and examination systems prevalent in India need to be thoroughly modernised.

Financial Institutions

Banks, financial institutions, investment institutions, Governments, trusts, and other financial mediators which channelise the national savings into industrial enterprises need to redefine their criteria and approach in project evaluation, monitoring, and disposal by adopting a more scientific conception of techno-economic viability. In other words, "bankable" proposals should be "long-term bankable", not just "bank- rollable".

□

Forging New Links : Foundation For Innovation & Technology Transfer

Prem Saran Satsangi

Since its inception, IIT (Delhi) has made special efforts to reach out to the needs of industry through sponsored and joint research, technology transfer, consultancy and testing. With a view to achieving a quantum jump in the level of collaboration and interaction with industry and other user organizations on programmes of mutual interest, the Institute has set up a Foundation for Innovation and Technology Transfer (FITT). The Foundation draws upon IIT (Delhi) as the primary resource, supplemented by expertise from other IITs, R&D organizations, consulting engineers, marketing and management experts to serve the industry and other user organizations.

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Indian Institute of Technology (IIT) Delhi, the youngest among the five institutes of national importance was set up under the Institute of Technology Act, 1961, as amended by the Institute of Technology Act, 1963. Early sixties was a period of youthful exuberance when strong foundations were laid in formulating a dynamic academic policy. The next decade was a transition from adolescence to maturity, when post graduate programmes and schools of research were established in the academic departments and interdisciplinary activities given special emphasis. This decade witnessed a noticeable shift from fundamental research in basic and engineering sciences to investigation of problems of direct relevance to the needs of the country through time-bound research and consultancy projects for solving live industrial problems. The third decade had been to a large extent, a period of stabilisation and consolidation when special attention was given to emerging areas identified at the national level such as atmospheric science, laser applications, thin film technology, microelectronics, bio-technology, energy, transportation, microprocessor applications, computer science, optical communications, signal processing, computer aided design and manufacturing, artificial intelligence and robotics.

International Collaboration

In order to remain at the forefront of advancement of science and technology, the Institute has collaborated with some of the foremost institutions in U.K. The Institute has extended academic and research collaboration to several Institutes of excellence in industrially advanced countries other than *the United Kingdom, such as France, Switzerland, U.S.A., Norway, Japan and Germany.* Plans are being formulated for extensive collaborative links with the newly established Benha Higher Institute of Technology in Egypt. In 1988 for the

first time, the Institute launched a programme to provide assistance to develop the infrastructure and faculty expertise at a sister institution in a developing country in the form of the IIT-Tribhuvan University (Nepal) Co-operative Agreement. We have also signed a memorandum of understanding (MOU) with the International Centre For Public Enterprises in Developing Countries in Yugoslavia for collaboration in the area of management of public sector undertakings. A student exchange programme with University of Lyons in France has been finalized, and a scheme under the sponsorship of the Asian Development Bank for exchange of post-graduate students with other developing countries has been put into operation. The programme for training personnel in Renewable Energy Sources from various developing countries under the sponsorship of the United Nations University has been further renewed. A new dimension has been added with the signing of a MOU with the University of Massachusetts at Amerst (U.S.A.) which provides exchange of undergraduate students annually between the two institutions for durations upto one academic year to pursue full-time studies at the respective exchange institutions.

Over the years the level and extent of industrial interaction are continuously growing. Industrial R & D (IRD) Unit was set up in 1974 to co-ordinate the activities of sponsored research and industrial consultancy and provide service to the industry and principal investigators and consultants at the Institute. The assigned functions of the IRD Unit include: sponsored research projects; consultancy jobs; patents and transfer of know-how; foreign collaboration with universities/ research institutions; collaborations with institutions in India; and industrial interaction. IRD is responsible for efficient administration of contract negotiations, patent applications, management of research and development funds, purchase of necessary equipment etc.

Achievements in Industrial R & D

Consultancy activities have been growing over the years with the industry reposing full confidence in the institute to solve R & D problems (figure 1). During the year 1991-92, the Institute provided 270 consultancy services to the tune of Rs. 85.3 lacs. In 1991-92, 51 new sponsored research projects were taken up with the funding inflow of Rs. 5.26 crores (figure 2).

Table 1 provides an illustrative list of a few major consultancy projects undertaken by the Institute in recent years. Table 2 lists some of the significant sponsored research projects which have been in operation at the Institute during the years 1984-92.

A few of the technology transfers, already made or ready, are given below to illustrate the range of expertise available in the Institute:

* Anaerobic biomethanation technology for treatment of distillery effluents
* Charred biomass briquetted fuel
* NMR spectrometer for evaluation of content of oil seeds
* Instantaneous breaking system for induction motors (upto 50 hp)
* Twin cassette recorder
* Biomass fuelled gasifier-engine genset/pumpset system
* Bioconversion of lignocellulose biomass into ethanol and co-products
* Braille duplication sheets and duplication machine
* Transfer printing process for transfer of design of 100% polyester cotton blended fabrics and garments.

Foundation for Innovation & Technology Transfer (FITT) : *Raison d'etre*

The development of technology requires an environment which encourages innovation and creativity. Such an environment can be provided through the development of an effective synergistic relationship between academia and industry so that creative people with fundamental knowledge and exploratory research provided by academia are coupled with the motivation, resources and the means to translate new ideas into commercial products and processes provided by the industry. Inspite of the continuously growing interaction with industry, there has been little substantial technological fallout of Institute's R & D work. There are a number of inhibiting factors contributing to this state of affairs. Major amongst them are:

* Lack of adequate communication between the industry and the institute leading to an inadequate appreciation of each other's needs and constraints
* Lack of guidance by industry as to what their strategic needs are to enable channelisation of academic R & D towards their solutions
* Lack of an interface to translate research results into commercial products and processes
* Gaps in perceptions of the time frame for carrying R & D work.

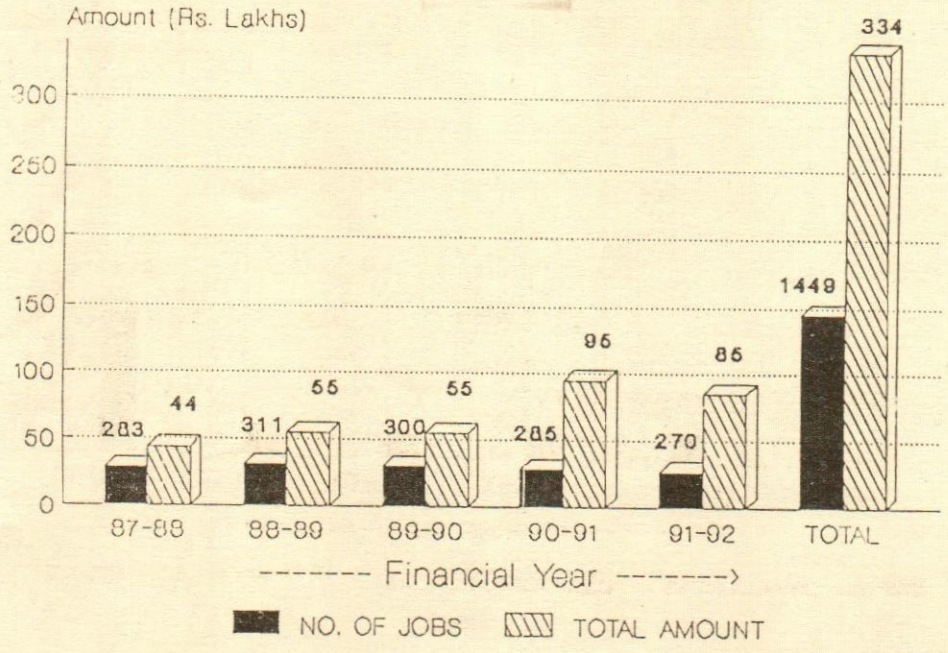
Table 1 : Major Consultancy Jobs

1. Risk Analysis due to Accidental Release of Toxic Gases especially Gases like Chlorine, Ammonia, HCN, etc.
2. Rotating Stall Studies on a Compressor Stage of the GTX Engine.
3. To Conduct Bench Scale as well as Pilot Plant Loop Studies in order to Generate Experimental Data for Designing Slurry Pipelines for Feeding Coal to the Various Steel Plants.
4. Diagnostic Load Tests for DDA Houses in Shalimar Bagh in Five Parts.
5. Development of Polymer Alloys.
6. Development of Technology of Fabrication of all Welded Heavy Duty Wire-wrapped Liner having Keystone Shape Opening.
7. Reliability Availability Maintainability (RAM) Analysis of Drilling Rigs.
8. Design Fabrication and Testing of a Prototype Microfilter Unit.
9. Control System for Cross-regulation of Gates of Irrigation Canal in Chambal Region.
10. To Carry Out the Design and Development Work of Hydrocyclane in Malang Khand.
11. Advice on the Production of Single Cell Oil from Mollasses.
12. Design of Maintenance Planning and Control System for Open Cast Mines/Phase-I.
13. Designing of a Microprocessor Development-cum-target System Based on 8085 A.
14. To Develop Methodology & Software for Pipeline Transport of Waxy Crude Oil.
15. Dynamic FEM Analysis of Ship and Related Design.
16. Investigation of Erosive Wear Behaviour of Pipe Bend Materials in Pneumatic Transport of Lime and Coal Dust.
17. Air Pollution Control in Coal Fired Furnace.
18. EIA (Air) Studies for Panipat Thermal Power Plant.
19. Impact of Surface Transport on Air Environment of Delhi.
20. Design, Demonstration and Evaluation of Solar Heating and Swimming Pool at Lucknow, Phase - II.
21. IIT Delhi- CDOT Cooperation on the Development of Application Softwares in Meteorology for Parallel Processing Super-computer (PPS).
22. Development of Signal Processor for Radar Cross Section Measurement System (RACS).
23. Study on Mixed Surfactant Systems.
24. Computer Modelling Project for the Rural Energy Sector of India Phase-I.
25. MAC Layer Bridge: Design and Assistance in Development and Implementation.
26. Development of a Driving Band Ring for AIFS Projectiles.
27. Feasibility Study on the Design of a 2M Watt. Separately Excited D.C. Motor Speed Controller for Electric Propulsion for Operation of DC Battery Supply.
28. Improved Strength of Nylon 6 Tyre Cord.
29. Condition Based Maintenance of Diesel Locomotives Phase II.
30. Development of SAW Expander/Compressor Sub-System.
31. Report on Development of Communications Industry in India.
32. Investigation of Polymer Composites for Microwave Absorption.
33. Finite Element Analysis of Right Bank underground Power House Cavarn - Sardar Sarover Project, Gujarat - Phase I.
34. Formulation of Hardware and Software Specifications for Fault Repair System.
35. Simulation and System Design Studies for a Model for HF Digital Radios.
36. Optimization of Fermentation Conditions for Rhizobium Production.
37. Development of Blends/Alloys of Polyvinyl Butyral with other Polymers.
38. Application of Reverse Osmosis for Chemical Recovery and Treatment of Textile Process House Effluent.
39. Matched Phase Shifter Development (MPSD).
40. Derivation of Real-Time Flood Forecasting Computer Model for Icha and Chandil.
41. Design and Development of an Experimental Fibre Optic Prototype System for Measurement of Currents upto 1000 amps on H.V. Lines.
42. Power System Security Analysis.
43. Air Pollution Dispersion Modelling for Nimbahera/Mangrol/ Chambhupura Plants of J.K. Cement (all in Dist. Chittaurgarh, Rajasthan).
44. Application of Shellac in Water Treatment,.
45. Development of Methodology for Condition Monitoring of Critical Rotating Machines of BTPS through Wear Debris and Degradation Analysis of Lubricating Oil.
46. Proof Checking of Design/Drawings for Paint Tunnel in Rail Coach Factory at Kapurthala.
47. Pulsed Plasma Energisation for Fluid Gas Cleaning of SO2 and NOx.
48. X-band Phase Shifter Driver Development.
49. Evaluation Study on IREP Programme in Two Blocks in Haryana State.
50. Development of Blends of Liquid Crystalline Polymers and Engineering Thermoplastics.
51. Microprocessor Controlled Motor for Conversion Kit (Conversion Kit for the Introduction of Flexible Repair Weaving in Ordinary Flat Jute Looms).

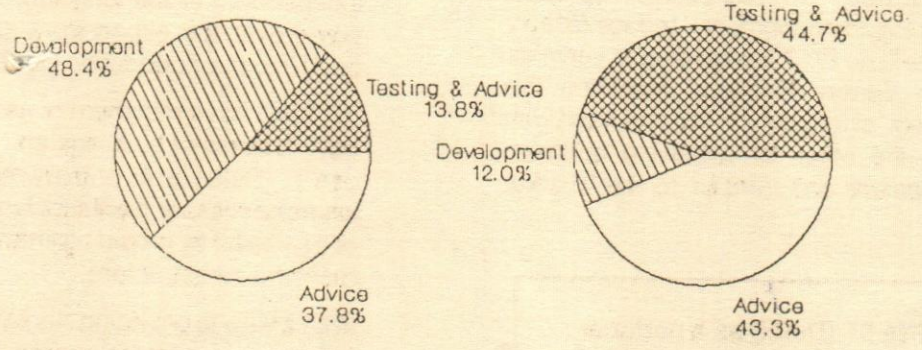
Table 2 : Significant Research Projects

1. Development of SOI MOS Structures on Polysilicon, Buried Insulator and their Application to 3D CMOS Technology.
2. Development and Analysis of Short Fibre Reinforced Thermoplastic Composite Systems for Engineering Applications.
3. Wear Resistant Tribological Coatings.
4. Signal Processing Techniques, Algorithms and Architecture for Phased Array Systems.
5. Development of C-band Dual Mode Reciprocal Ferrite Phase Shifter.
6. Test and Failure Research of Fallope Rings and Cu-T under the Family Welfare Programme.
7. Development of Software for Numerical Control Machine Tools.
8. Development of Interactive Facility for Digital System Design.
9. Development of Route Interlocking System using Microprocessor for Indian Railways.
10. Development of Yarn Fabric Structures for better Apparel Comfort with Air Texturing using Cotton and Cotton/Man -made Fibre Blends.
11. Processing and Sub-systems for Radar and Sonar Applications.
12. Composite Coordination R & D Project on Development of Resin Moulding Components, Curing Agents etc. for Use in Composite Industry.
13. Design and Development of Air Filter for Combat Vehicles and Characterization of Dust Particles.
14. Development of Integrated Design Automation Languages (IDEAL) and Associated Support Software for Integrated Design System Automation (IDEAS).
15. Polymer Ceramic Composites and their Use in Transducers.
16. Rotary Steam Gasifier for Thermal Electrical Application using Rice Husk (250 kg/ltr).
17. Thin Film Fabrication Studies and Devices Possibilities.
18. Development of Engineering Prototype Units of Route Interlocking System using Microprocessor for Indian Railways.
19. Development of Millimeter Wave IC Components at KA-Band.
20. Process Optimization of Restriction Endonucleuses large scale purification and stabilization.
21. Prevention of Disabilities among Agricultural Workers.
22. Role of Interface in Fibre Reinforced Composite Integrity.
23. Development of Universal interlocking system using microprocessor for Indian Railways.
24. Laser generation of High Tc materials by abloation and characterisation by Laser Raman and Infrared Spectroscopy.
25. Design, Development, and Evaluation of Solar Kier.
26. Modelling Simulation Prototyping and CAD Tool Development for Application Specific SAW Devices (ASSAD) in Radar and Communication.
27. Route Interlocking using Microprocessors for Indian Railways.
28. Studies in Chemical Processing of Silk.
29. Development of Integrated Design Automation Language (IDEAL) and Associated Support Software for Integrated Design Automation System (IDEAS)-Phase-II.
30. Development of a Parametric Sonar.
31. Establishment of Electronics Resource Centre (Manpower Component) for Poly-technics and Engineering College at IIT Delhi.
32. Advanced Object Visualisation Techniques for Imaging Sonars (ADOVIT).
33. High Power Microwave Plasma Interaction Using Slow Wave Structures.
34. Microbial Synthesis of Lipases.
35. Basic & Biochemical Engineering Studies on the Development of Stable Plasmid Vectors in Corynebacteria and Fusion Hybrids Between Bacillus and Corynebacteria.
36. Production and Application of Microbial Polysaccharide Xanthan.
37. Development of a Gantry Robot and Its Integration into Advanced Manufacturing System.
38. Biomass Related Action Research Centres (BGTU).

CONSULTANCIES JOBS
(APRIL '87 - MARCH '92)
CUMULATIVE OF ALL DEPARTMENTS/CENTRES



Classification into Various Types



(i) %AGE SHARE BASED ON AMOUNT (ii) %AGE SHARE BASED ON NO. OF JOBS

FIG. 1

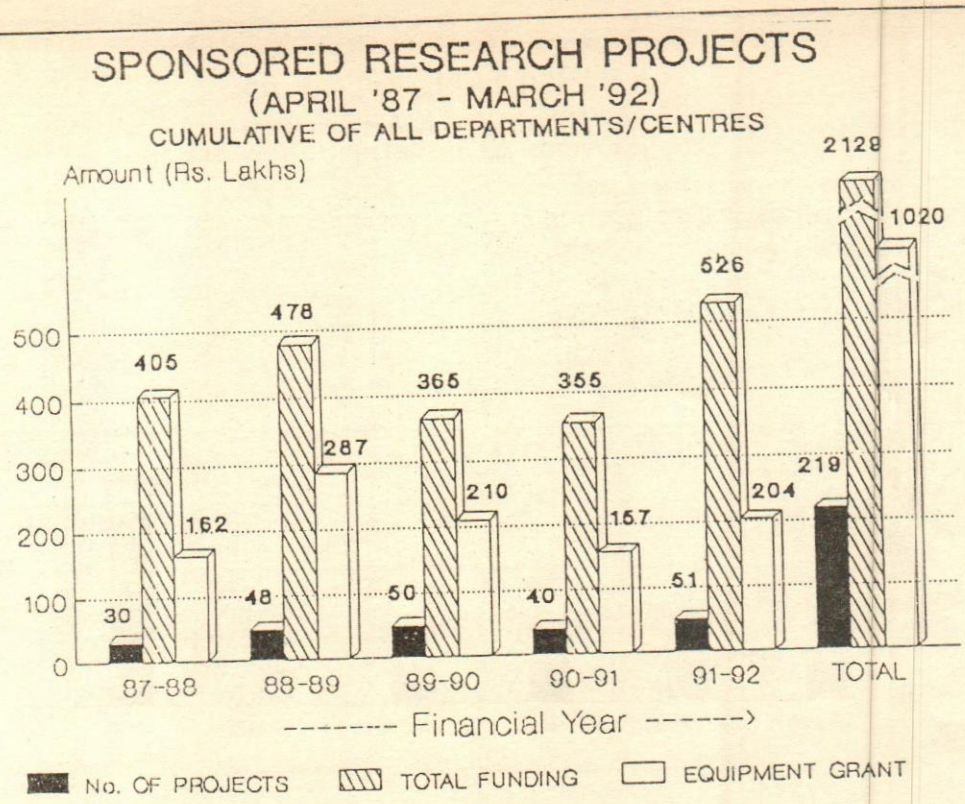


FIG. 2

To fully utilise IIT (Delhi) as a national resource and as a partner in national development, there is a need for a quantum jump in the extent of its interaction and collaboration with industry. In order to achieve this interaction without compromising its primary goals and objectives, to improve communication between the IIT and the industry and to provide an effective delivery system for technology development through various stages of the research, pipeline to transfer a research idea to the market place, the Foundation for Innovation and Technology Transfer (FITT) has been set up as an autonomous technology development interface closely linked to the Institute. The FITT is expected to serve as an "Impedance or Variety Manager' matching the "impedance or variety" of industry on the one hand with that of the IIT on the other for achieving optimum technology development and transfer to the "market place".

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Basic Features of FITT

In order to identify the basic features and programmes of FITT, the various successful models of a meaningful partnership between the industry and the higher technological institution were examined. Its basic features are:

- FITT will work as a commercial organisation and adopt an industrial culture and ethos in its functioning. Since it is proposed to be financially independent in the long run, the surplus of income over the expenditure shall be ploughed back into the Foundation Corpus Fund.

- FITT will have minimum of its own fixed assets both in terms of buildings and equipment. It will use IIT (Delhi) as its primary resource. However, where necessary, it will supplement the resources of IIT (Delhi) by providing financial inputs to augment the infrastructure.

- With a view to providing single window service to industry with professionalism, FITT will supplement the resources of IIT (Delhi), by utilising, on a commercial basis, the expertise and resources available elsewhere such as at other IIT's, R&D organizations, consultancy firms, marketing and management firms, etc.

- FITT will appoint a minimum of full time core staff who possess broad-based expertise and are able to adapt themselves from project to project as required to allow maximum flexibility in manpower utilisation. The full time core staff will be supplemented by project staff who may be drawn temporarily on deputation from IIT (Delhi) or other organizations.
- FITT will seek corporate membership from private and public sector industry, services sector, ministries and organizations, industry associations and financial institutes. It will provide services to its corporate members on concessional and preferential basis.
- Financially, FITT will be independent of IIT (Delhi) and will not pass on its financial liability to the Institute. It will generate its own finances through governmental grants, gifts and donations, corporate membership fees, overhead on projects and services, technology sales, patent rights, royalties, consultancy fee etc.

Objectives of FITT

The broad terms of reference of FITT are to add commercial value to academic knowledge and to market the intellectual and infrastructural resources of IIT (Delhi) for national development. Emanating from these broad terms of reference, the specific objectives of FITT include the following activities:

The broad terms of reference of FITT are to add commercial value to academic knowledge and to market the intellectual and infrastructural resources of IIT (Delhi) for national development.

- Prototype and pilot plant development leading to commercialisation of products and processes for which initial research has been done as student projects/sponsored research/in-house research of institute faculty
- Development of product and process technology specifically requested for by industry to a commercial viable level
- Technical support to small scale industry and engineering entrepreneurs especially in the initial nursery stage
- Exchange support to small scale industry and engineering entrepreneurs especially in the initial nursery stage
- Exchange between IIT (Delhi) and industry and institution of fellowships for leading Indian scholars to work on development projects of their own choice but in the areas of interest to IIT (Delhi)
- Promote, foster and engage in goal oriented industrial research and development both at industrial premises and at IIT (Delhi)
- Undertake co-operative R&D programmes jointly with industry/industry associations
- Foster exchange of information between IIT (Delhi) and industrial concerns including future vision seminars on forecasting of trends in technology development in individual generic areas of interest at the IIT and industry
- Motivate IIT (Delhi) faculty to undertake market/product oriented problems
- training industry personnel and IIT (Delhi) UG/PG students to become technical experts on specific products/processes (with the subsequent possible transfer of experts to industry).

Programmes & Services offered by FITT

In conformity with its objectives, the FITT offers the following programmes in the first year of its existence:

(i) **PDP—Product/Process Development Programme**: The "front end" of the FITT will be a marketing group which will explore developments both in and outside IIT (Delhi) with a view to identifying in-house developments with a potential for industrial applications and also industrial needs for products, processes and services that the FITT may provide. To achieve this objective, comprehensive data banks will be generated on all technical work being done at IIT (Delhi) including student projects, faculty research, etc. as well as on faculty expertise and infrastructure facilities available at the Institute. Similar data bank will be prepared for Indian industry followed by plant visits to facilitate close interaction. Experts will also be nominated on the evaluation committee for B.Tech./M.Sc., M. Tech. and Ph. D projects to get first hand information on latest development in research at IIT (Delhi). After identification of a promising product or process and a detailed analysis of its feasibility, a work plan and

a budget will be formulated and a project team will be assigned for its completion within the time and resource constraints established.

(ii) **TIP—Technology Initiatives Programme**: a significant portion of the resources of FITT will be set aside to support technology thrusts at the Institute and foster exploratory work in identified generic areas of technology that may lead to commercial products on a long term basis. An illustrative list of generic technology areas of strength of IIT (Delhi) is given in Table 3.

Table 3 : Illustrative List of Generic Technology Areas Of Strength of IIT, Delhi

- Software Engineering
  - Development of CAD Environment
    - CAD for VLSI
    - CAD/CAM/CIM
    - CAD for Engineering Systems
  - Computer Communication Networks
  - Parallel Computing
  - AI & KE
  - Planning Technology
    - Energy
    - Transport/Communication
    - Technology Forecasting and Technology Assessment
- Micro-Electronics
  - VLSI & SAW Technology
  - Microwave & Millimeter Wave Technology
  - High Resolution Sonar
  - Phased Array Radar System
- Sensor Technology
  - Fibre optics
  - Bio-sensors
- Photonics Technology
  - Optical fibres
  - Holograms
- Semiconductor Material Technology
  - Thin films
  - PV Devices
  - IR Detectors
- Fuel Efficient Engineers
- Pollution Control and Waste Management
- Decentralised Energy Systems
- Energy Conservation
- Chemical / Polymer Technology
- Bio-Chemical Technology

(iii) **TAP—Technology Advancement Programme**: FITT will undertake entrepreneur development programmes for young engineering graduates through training programmes in the technical and managerial aspect of technical businesses and by providing assistance to develop their enterprise through "technology business incubator programme". In addition, the programme will operate the FITT Enterprise Forum for offering help in evaluation, planning, product development, production, marketing, staffing, financing etc.

(iv) **TES—Technology Extension Service:** FITT will provide consultancy services and material and product testing services to industry over a wide range of science and engineering disciplines.

(v) **FVS—Future Vision Seminars**: FITT will organise technology-strategy awareness programmes for industry in generic technology areas of strength of IIT (Delhi).

(vi) **ISS—Information Support Services**: It is proposed to establish network links with international/national data-bases to provide information support services such as bibliographic services, abstracting services, patent search, technical expertise profiles, materials and services availability etc. In addition information will be provided to industries through the following publications for use by industry:

- Periodic Research Report giving information on R & D results in IIT (Delhi)
- Periodic Progress Report on the programmes and services offered by FITT
- Periodic Teaching Bulletins on training courses available under regular, and continuing education programme of the Institute.
- Newsletter
- Aperiodic Technology Status Papers or Monographs in emerging areas of technology.

(vii) **HRDP—Human Resource Development Programme:** Integrated management/technology development short courses for middle level managers/technical executives and integrated graduate development courses for young managers/technical executives on part-time modular basis will be offered both on campus and at industrial work sites including tutored video instruction (TVI) and computer aided instruction and evaluation (CAI&E) mode of distance education. In addition, the programme will provide access to the Institute library of video based self-learning modules and to its TV Studio multi-media expertise in the

development of special video-based modules on request of industry.

(viii) **SPMS—Strategic Planning and Management Services**: This programme will provide assistance in the formulation of business plans, strategic planning and management.

(ix) **RPP—Research Partnership Programme:** FITT will undertake sponsored and joint research projects for transfer of technology by matching the technology based areas of strength of IIT (Delhi) with the needs of the industry/user organisations and seeking matching funds from research funding agencies. The project proposal must be co-authored by an Indian Industry and IIT (Delhi) faculty. Also, the participating company must make a matching contribution in the form of services, equipment or money depending on its size.

(x) **SOP—Summer Opportunities Programme**: FITT will organise a Summer Industrial Opportunities Programme under which faculty members identified by the industry and user organisations will spend six to eight weeks in industrial locations in summer. This will make available to industry high level expertise, and to the faculty exposure and insights into real life industrial problems.

(xi) **CSP—Conferences and Symposia Programme:** FIITT will organise conferences, symposia and technology meets in areas of strategic needs of Indian industry including case studies of technologies in specific generic areas ready for exploitation.

(xii) **CIP—Communication with Industry Programme:** In order to communicate with the industry for marketing FITT/IITD, FITT will

- arrange meeting at CEI/FICCI/PHD Chambers of Commerce /ASSOCHAM /ICICI/IDBI etc. to explain the concept of Foundation and present case studies of promising technologies;
- publish Technical Newsletters;
- appraise the campus selection teams from Industry, regarding the latest at IITD and FITT;
- organise seminars at industry premises;
- schedule visits to Industry by the Managing Director of Foundation and Dean, Industrial R&D of IITD;
- arrange panel discussions on Government policy and other relevent areas;
- nominate industry representatives on under graduate/post graduate project evaluation panels;
- coordinate the visit of faculty member, and supervise the B. Tech. practical training in such a manner that it provides for a stay of atleast one month in the same industry and it may be linked with the Summer Industrial Opportunities Programme;
- promote programme on faculty achievement to Industry and adjunct appointment of industry personnel at the Institute;
- create technical study centres at industry; publicise R & D activities of IITD through displays in stalls in Exhibitions arranged by Trade Fair Authority of India and other organisations.

Resource Generation

Financially, FITT will be independent to IIT Delhi. The Ministry of Human Resource Development has committed to provide seed money for the FITT for the initial 3 years of its operation. Gradually, FITT will earn its own expenses. FITT will extend its corporate membership at a specified fee to private and public sector industry, services sector, ministries and organisations, industry associations and financial institutes, which will be able to avail of its information support services, human resource development programmes, consultancy and testing services and technology transfer services on a preferential and concessional basis. Gifts of movable property may be received from persons/associations interested in the aims and objectives of the FITT. Overhead charges on services provided to corporate members as well as to non-members on an *a-la-carte* basis such as consultancy and testing services, information support services etc. will generate additional resources.

Mechanisms of interaction

The present mechanisms of interaction between the Institute, the industry and other user organisations operate, by and large, on an 'as and when basis' through

informal and, often, chance interactions. FITT has been conceived to provide a framework for a more formal and effective relationship between the Institute and industry on a mutually supporting basis.

Corporate membership

Corporate members will have the following privileges:

(i) A continuing contact through a wide range of services and a preview of Institute R&D programmes of interest to them.

(ii) Corporate members will be entitled to services such as, information support, FITT publications, visits to the Institute, industrial opportunities programmes etc. on a regular and continuing basis against the membership fee.

(iii) Each corporate member will be assigned a full-time core staff of FITT to work closely with contact person(s) identified by it to promote and facilitate programmes of mutual interest. The core staff will consist of professionals with industrial experience, and a thorough knowledge of the expertise, facilities and programmes of the Institute: they will respond to specific enquiries of corporate members; visit various divisions of member companies to identify interests, problems and appropriate interfaces with IIT (Delhi); alert corporate members to special opportunities (HRD programmes, research developments, patents, etc.) at IIT(Delhi) that may be of interest to them; and fix up meetings, identify faculty members who may serve as consultants and advisors to the corporate members.

(iv) Corporate members will be entitled to a preferential access to FITT/Institute programmes, such as, conferences/symposia, joint/consortia research, technology transfer, and HRD programmes. They will be offered discounts in the registration fees and other chances for participation in programmes of FITT.

(v) Corporate members will form a constituency for purposes of representation on the Governing Council of FITT. In this capacity, they will have opportunities to shape and guide the R & D agenda of the FITT, its policies and procedures consistent with the needs of the corporate members.

To become a Corporate Member, industry and other user organisations will pay an admission and an annual fee, commensurate with their size, and value of the services offered by FITT.

Ordinary members

Individuals over 18 years of age or unincorporated bodies having interest in the fields covered by the activities of the Foundation can be admitted as ordinary members of FITT on payment of the annual subscription.

Services to non-members

FITT will also provide its services, on an *a la carte* basis, to industry and other user organisations who are not Corporate Members of the Foundation. However, these services will be offered, subject to availability, at normal charges.

Concluding remarks

Over the past decade, there have been several major initiatives in the developed world to forge new alliances and collaborative arrangements between governments—both state and centre, academia and industry. These arrangements are based on mutuality of interests of participants, and have evolved in response to the increasingly important role of technology in industrial development. Governments have promoted and supported these alliances to attract hi-tech industry, generate employment and accelerate the process of economic development. Industry has joined hands with academia, in enlightened self-interest, to have access to the two most important ingredients of innovation process, namely, creative people, and bulk of fundamental knowledge and exploratory research. Academia have reoriented their goals and programmes, and broken themselves from the shackles of "ivory tower" image, to reach out to work with the industry and accept government support to participate in these collaborative arrangements. In taking these initiatives, academia is looking for improvement in the quality of academic programmes—its primary responsibility, and at the same time contributing directly to economic development by getting its laboratory research to the "market place". There are several successful examples of cooperative R & D, technology transfer and human resource development programmes around the world.

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As India enters the era of knowledge-based industry, with technology providing the cutting-edge for development, there is a need for forging new alliances between industry and academia with the government acting as a catalyst. Successful industrial innovations require substantial funding, large interdisciplinary teams and sustained efforts over several years. By international standards, the size of Indian enterprise is small which often limits the financial resources to subcritical level. We also face shortage of creative people especially in emerging areas of science and technology. In this background, the need for cooperative efforts which share people, facilities and funds is all the more pressing in India. FITT has been conceived to respond to this reality.

Acknowledgement

The concept reported in this paper is a result of a joint effort of a number of colleagues and has evolved through progressive refinements and discussions at multiple levels at the Institute-Industry Meet of representatives of industry and user organisations, Government of India, funding agencies and IIT (Delhi) and at the high-level meetings of subcommittees of the Institute under the overall guidance and stewardship of Prof. Navin C. Nigam, Director of IIT (Delhi) and Chairman, Governing Council of FITT. Particular mention must be made of contributions of Professor N.M. Swani, Former Director of IIT (Delhi), Prof. C.S. Jha, Vice-Chancellor of Banaras Hindu University, Prof. P.V. Indiresan, Former Director of IIT (Madras), and Prof. R.C. Malhotra, Director of IIT (Kanpur).

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Any fool can learn to stay within his budget. But I have seen only a handful of managers in my life who can draw-up a budget that is worth staying within.

—Nicholas Dreystadt

I once asked a farmer for direction to a neighbouring village and he told me you can't get there from here. I run into the same problem with senior managers when discussing corporate strategy.

—W.J. Reddin

Promotion of Cleaner Technologies in India: Status & Prospects

Vijay Kulkarni & Purushottam Khanna

Cleaner Technologies (CT) are the practical application of knowledge, methods and means so as to provide the most rational use of natural resources and energy and to protect the environment. Development and implementation of cleaner technologies warrant a co-ordinated endeavour on the part of R&D institutions, industry associations, financial institutions, and regulatory agencies. The current R&D on cleaner technologies is restricted to fringe issues of minor process modifications, resource conservation through good housekeeping practices, and waste recycle. The paper argues that the ultimate cleaner technology will be based on renewable resources as raw material and energy, and transformation through highly efficient biotechnology to produce environmentally benign products. Accordingly, the real issues to be addressed are ranking of production technologies based on resource-environment considerations in various industry sectors.

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Over the years, India has achieved a substantial measure of self reliance, as a result of policies initiated Second Plan onwards. The country now produces the entire quantum of coal, tractors and other agricultural equipments, some 80 to 95 per cent of steel, industrial machinery and machine tools, power generation and transmission equipment, mining and earth moving machinery, vehicles, nitrogenous fertilizers, drugs and drug intermediates, and more than two thirds of zinc, paper and newsprints and a variety of other industrial products.

The expansion in industry sector, however, has been towards capital and energy intensive sectors which are also the most polluting. Also, nearly 50 per cent of the industrial output in monetary items is contributed by over 2 million small scale industries which account for 60 to 65 per cent of the total industrial pollution. Also, the use of toxic chemicals in industry has grown phenomenally.

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Status of Pollution Control in India

Endeavours on environmental protection, so far, in India, have relied on strict regulatory measures. There are some two hundred enactments that have a bearing on environment. Those most relevant to industry are the Factories Act (1948), Water (Prevention and Control of Pollution) Act (1974), Forest Conservation Act (1980), Air (Prevention and Control of Pollution) Act (1981, Environment (Protection) Act (1986), and the Public Liability Insurance Act (1991).

As per Ministry of Environment and Forests (MEF) requirements, industrial units are required to obtain from the concerned State Pollution Control Board a consent to operate the unit. Such consent is subject to the unit complying with the standards prescribed by the Board. A provisional consent is given if the unit has an acceptable programme for installing necessary measures for controlling pollution. Failure in complying with the prescribed standards or conditions renders the unit liable for prosecution. By mid-1991, 4500 prosecutions have been made by the central and state pollution control boards of which 1133 (about 25 per cent) have been decided.

Despite legal mechanisms for environmental management, only about 50 per cent of the large/medium scale industries have provided complete/partial emission/effluent control systems and many of these do not achieve stipulated standards. Further, the small-scale industries (SSIs) have not yet been subjected to rigorous pollution control.

In 1991 MEF has formulated a 15-Point Action Plan under which action has been initiated to control pollution in the 17 categories of major polluting industries (Table 1) and directed State Pollution Control Boards to ensure the compliance of standards in these industries. Pollution Control Status of 17 categories of industries in 23 States/Union Territories including all major industrial estates have been collected, collated and compiled. Defaulting units have been identified and action is being taken against them.

Table 1 : Priority Industry Categories for Pollution Control Identified by Ministry of Environment and Forests

Sr. No.	Category
1.	Cement
2.	Thermal Power Plants
3.	Iron and Steel
4.	Fertilizer
5.	Zinc Smelter
6.	Copper Smelter
7.	Aluminium Smelter
8.	Oil Refinery
9.	Pulp and Paper
10.	Basic Drugs
11.	Dye and Dye Intermediates
12.	Pesticides
13.	Petrochemicals
14.	Tanneries
15.	Pharmaceuticals
16.	Sugar
17.	Distillery

Environment - Industry Policy Linkages

The basic structure of Industrial Policy in India has been guided by the Industrial Policy Resolution of 1956. From time to time, the Industrial Policy has been modified through statements in 1973, 1977, 1980 and recently in 1991.

The goals of industrial policy in India are rapid expansion of opportunities for gainful employment, progressive reduction of social and economic disparities, removal of poverty and attainment of self reliance. Promotion of small scale industry on one hand and restriction of the size of large industries through Monopolies and Restricted Trade Practices Act have been the tools for achieving these objectives. Till recently, an industrial license was required for establishing a new unit, expansion of the existing units, change in the products as also change of location. As per Industrial Policy Statement of 1991, industrial licensing has been abolished for all projects except for industries related to security and strategic concerns, hazardous chemicals, highly polluting industries and items of elitist consumption.

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The role of Ministry of Environment and Forests in industrial development has been, so far, envisaged as control of pollution from the industries whereas the larger issues of resource conservation and carrying capacity based planning of industrial estates have been overlooked in the industrial statements over the years.

In the industry sector, the major environmental implications arise from small-scale industrial (SSI) units. The Government of India has a policy of promoting the steady growth of the SSI sector and has accordingly introduced a large number of fiscal incentives and other measures. Though the labour and capital productivity of this sector is comparable to that of medium and large industries, its material productivity is usually lower, thereby resulting in more pollution per unit of output.

Some of the problems due to obsolete technology associated with higher levels of pollution employed by Indian industries relate, in addition to inadequate infrastructure for implementation of legislation, to conces-

sions given to small scale industries and policy of administered prices for large industries such as steel, fertilizer, cement, power generation, alcohol and drug industries thereby failing to introduce competition. Chemicals already banned or obsolete in other industrialised countries are still being produced in India. In other cases, relatively dirty industries or processes which find themselves under considerable economic and environmental pressure in developed nations, have been installed in India, exacerbating the environmental problems associated with industrial sources.

The protection offered to industry and the emphasis on decentralization of industrial development have resulted in the adoption of sub-optimal scales of production, most notably, for some sectors such as pulp and paper, sugar and distilleries, leather tanning and chemical industry. India's chemical plants are tiny by international standards. In the case of many products, capacity of a single plant in developed countries is higher than the entire installed capacity of the product in India, which itself is distributed in large number of units. Adoption of small production scale frequently increases the cost of production and cost of pollution control, making it financially difficult for small companies to meet emission standards.

Technology employed by the Indian industry lags behind that of Newly Industrialised Countries (NICs) due to relatively low level of indigenous technology which is, inturn, due to low level of R & D undertaken and stringent control and regulation of direct foreign investment and technology agreements till recently. Though technology was imported in certain cases, gap exists in all important industries (Table 2).

Table 2 : Technology Gaps in Select Industries in India

Sr. No.	Industry/Product	Technology Gap (no. of years)
1.	Cement	10
2.	Steel	10-15
3.	Aluminium	2 - 5
4.	Foundries	10
5.	Engineering	10
6.	Agro-chemicals	10-15
7.	Tyres	10-15
8.	Tobacco	10
9.	Paper	15-20

Source : ASSOCHAM (undated)

Pollution Prevention v/s Control

The options for environmental management in industry sector include, on the one hand, reactive control measures such as end-of-the-pipe (EOP) treatment technologies and media-specific regulations for waste discharges, and on the other, anticipative and preventive strategies such as adoption of cleaner technolgies of production and integrated planning based on considerations of regional carrying capacity. Environmental policy for industry in India, till recently, had focused mainly on pollution control through end-of-the-pipe (EOP) treatment which allows the wasteful use of resources and then consumes further resources to solve the environmental problems in a particular medium. Also, EOP control technologies, more often than not, transfer pollutions from one environmental medium to another and consume resources out of proportion to the accrued benefits.

Future raw material and energy scenarios, the impact that the industry and its products have on the natural resource base and environmental quality, and the necessary thrust being given to industrial growth in our country, warrant a comprehensive strategy to deal with environmental and economic problems of the industry. As new industries come up to meet developmental imperatives, it will be necessary to impose more stringent emission standards progressively to maintain acceptable levels of environment quality. If the option of more intensive pollution control is to be avoided in the future, then it is necessary to adopt a strategy of pollution prevention based on technologies that conserve resources, minimize pollution, and reuse wastes as secondary resources to the extent possible.

As new industries come up to meet developmental imperatives, it will be necessary to impose more stringent emission standards progressively to maintain acceptable levels of environment quality.

Concept of Cleaner Production

Cleaner production has been defined by UNEP as the conceptual and procedural approach to production that demands that all phases of the life cycle of a product should be addressed with the objective of prevention or minimization of short and long term risks to humans and to the environment. The goal of cleaner production is

essentially that of sustainable development; production processes, product cycles, and consumption patterns which allow for human development, and the provision of basic needs without degrading or disrupting the ecosystems in which human development must operate. The central tenets of the cleaner production philosophy are preventive and integrative measures.

Cleaner Technologies of Industrial Production

Cleaner Technologies (CT) are the practical application of knowledge, methods and means so as, within the needs of man, to provide the most rational use of natural resources and energy and to protect the environment. Cleaner Technologies are based on improved manufacturing methods that require less raw materials and energy to obtain equitable levels of output of identical or better quality. CT also make greater, if not full, use of wastes and recyclable materials and are dependent upon innovation and high level of cooperation between different industries, particularly when exchanges of certain wastes are involved.

There are three broad elements of cleaner technologies, viz.

* *Resource conservation technologies* aiming at waste minimization at source through product change (substitution/conservation/composition); production process changes involving raw material changes, technology changes and better house keeping
* *End-of-Pipe treatment technologies* designed to recover raw materials, energy, water and by-products
* *Waste utilization technologies* for reclamation and utilization of wastes as secondary raw materials.

The concept of cleaner technologies is being advocated in different parts of the world under various names such as low- and non-waste technologies, environmentally sound technologies, waste recycling, residue utilization, and resource recovery technologies. The ultimate cleaner technology will be based on renewable resources as raw material and energy, and transformation through highly efficient biotechnology to produce environmentally benign products.

The elements of cleaner technologies are presented in Fig. 1. Selection and application of cleaner technolo-

Source Reduction

Product Changes

- Product Substitution
- Product Conservation
- Product Composition

Production Process Changes

Input Material Changes

- Material Purification
- Hazardous/Recalcitrant Material Substitution
- Non-renewable Resource Substitution

Technology Changes

- Process Changes
- Equipment, Piping, Layout Changes
- Automation
- Changes in Operational Settings

Recycle/Reuse

Use as Raw Material

- Return to Original Process Unit
- Raw Material for Another Process Unit

Material Recovery

- Processed for Resource Recovery
- Processed as by-product

Good House Keeping

- Procedural Measures
- Prevention of Emissions
- Management Initiatives
- Waste Stream Segregation
- Material Handling Improvements
- Logistics

Waste Utilization

- Raw Material for Another Industry
- Industrial Complexing
- Restoration of Environmental Quality

FIG. 1. ELEMENTS OF CLEANER TECHNOLOGIES OF INDUSTRIAL PRODUCTION

Cleaner Production	Major Barriers	Incentive Mechanisms
Initial Phase		
- Good house keeping - Input substitution - Waste segregation - Minor process changes	- Lack of information on waste reduction methods - Lack of technical expertise	- Information dissemination such as newsletters and technical workshops - Grants for waste audits
Capital Intensive Phase		
- Capital intensive investments, such as recycling or waste-water treatment equipment	- Financing not available - Lack of information on waste reduction methods	- Loan guarantees - State loans - Grants for project implementation - Interest subsidies - Tax deductions
R & D Phase		
- Research, development and demonstration of technologies	- Technology not available or not demonstrated	- Grants - Venture capitals - Dissemination of results

FIG. 2. ISSUES AND POSSIBLE INCENTIVES TO PROMOTE CLEANER TECHNOLOGIES OF PRODUCTION

Source : Yakowitz (1991)

gies require a comparative analysis and evaluation of various competing technologies based on economic, technological, social and environmental considerations. An overall approach to promotion of cleaner technologies is presented in Fig. 2.

The ultimate cleaner technology will be based on renewable resources as raw material and energy, and transformation through highly efficient biotechnology to produce environmentally benign products.

Major Issues in India

In considering technology as a tool to meet environmental and developmental goals and targets, objectives should be defined with regard to main contributions expected from the application of technologies, and barriers which restrict the acquisition of technologies.

The grossness of pollution in India due to inadequate enforcement of existing legislative framework indicates that there is huge potential for cheap improvements. The potential for cleaner production in India does not solely depend on western cleaner technologies. Advanced technology is a long way down the list of what is required. Far from being locked behind exensive patents barriers in the laboratories of the West, the devices best placed to bring about the most spectacular gains, especially in energy efficiency and pollution reduction, are decidedly low technology such as good house keeping and preventive maintenance, and they often pay for themselves within a year or two.

Technology transfer is a social and not industrial problem; it is not about handing over blueprints, it is about ensuring that the technologies will work. Access to technologies is more a perceived than real barrier. The really beneficial technologies were not pieces of equipments, but soft technologies — training in operation and maintenance methods, in particular—which have been historically neglected.

Any benefit from technology transfer is heavily dependent on the capacity of the recipient industry sector to manage the technological change. Such capacity building also encompasses the ability to make informed technology choices based on the technology

The grossness of pollution in India due to inadequate enforcement of existing legislative framework indicates that there is huge potential for cheap improvements.

assessment; to acquire and manage technologies according to its own developmental condition, needs and priorities; and to generate scientific knowledge and technical know-how. A technology which involves mere transfer of machines and chemicals will last as long as the creators of the material are around. What is needed is the training of people in skills and technologies to creatively adapt, innovate and invent new technologies appropriate to their needs.

Transfer of cleaner technologies is often discouraged because "polluting" technologies have a price advantage, current financial resources are insufficient to cover the incremental costs involved, and additional financial resources are not available. The cost difference between traditional and the cleaner technologies is aggravated by the failure to implement legal measures for pollutin control.

The major constraints in acquisition of cleaner technologies relate to lack of appropriate information and resulting misconceptions affecting various pertinent features of the technolgies to be transferred as well as their optimal functioning. For instance, certain process technologies may need continuous inputs and may break down if batch process is being used. However, in case of small scale industries, batch feeding rather than continuous feeding is a more realistic possibility. Also, the quality of raw material may be substantially different from the one for which cleaner technology has been develped, e.g. raw material used in Indian pulp and paper industry.

Industrial design parameters are crucial for newly introduced cleaner technologies since developers of such technologies in the developed countries have not accumulated experience in transferring and applying those technologies to developing countries. As a result, technologies exported to developing countries are often not adaptable to their conditions, infrastructure and environment. The cleaner technologies cannot be directly imported from successes abroad as perhaps possible for ad-on units such as technologies for ETP. Also technologies which were invented for temperate conditions may not be applicable to tropical countries.

Another major constraint to technology transfer is lack of information regarding local markets such as availability of trained manpower. This may result in over/under estimation of capital and operational costs. A combination of informational, financial, economic and legal measures, need to be devised in order to promote waste minimisation through cleaner technologies.

Development of cleaner technologies warrants inter disciplinary research. A systems approach comprising two inter-related subsystems—a production sub-system and an environmental sub-system is required for the objective evaluation of technologies.

A major factor that discourages entrepreneurs from preventing pollution is the perceived financial risk associated with the relatively new cleaner technologies. In many cases, such technologies may not even have been developed or sufficiently tested. Then, of course, there is the tendency of the industry to avoid environmental costs in favour of short-term gains. There is also lack of coordination and direction in R & D efforts and inadequate thrust for technology transfer from lab to commercial scale. These problems arise mainly due to the insufficient mission oriented approach of laboratories; inadequacy of design, engineering and fabrication facilities; inadequacy of funds for pilot-scale demonstration of laboratory results; and low value placed on technology transfer by scientific and technological personnel engaged in R & D work.

Strategies for Promotion of Cleaner Technologies

With the realization of limitations of pollution control approach and felt need for resource conservation, the focus of environmental management in India has now shifted to anticipation and prevention.

With the realization of limitations of pollution control approach and felt need for resource conservation, the focus of environmental management in India has now shifted to anticipation and prevention.

Further, with international standard for quality management and quality assurance (ISO : 9000 - 9004) introduced in 1987, focus in industry sector has now shifted from product quality to assessment of manufacturing process. In the wake of global awareness of environmental problems, clean performance would be the key foundation for industrial competitiveness of Indian industry.

A major challenge is to ensure that industry is strongly encouraged to:

Invest in cleaner technologies which minimise to the extent practicable, the energy, raw materials, and waste produced per unit of product

- Improve the production process and the state of the art of cleaner technolgies of production
- Minimize the use of inherently hazardous substances in the marketable outputs or as intermediates.

This could be achieved through demonstration, development and promotion of cleaner technologies through:

- *Provision of financial assistance for R&D* and installation of demonstration plants. A major part of such assistance should go to the industry
- *Provision of economic incentives* such as subsidies, tax rebates and loans to industry
- *Internalisation of environmental costs* through a system of taxation on wastes. Among the waste taxes, the concept which has found widest application is that of effluent changes
- *Ecological grouping and shifting of industries.* The supportive and assimilative capacities of a region should be assessed for location of economic activities which create wastes in the vicinity of those which can utilize these wastes so that the net use of resources and the net pollution load is minimized while the unavoidable residuals are treated jointly and disposed of
- Formulation of standards in terms of waste discharge per unit quantity of raw material
- Introduction of legal measures to ensure that cross-media transfer of pollutants is minimized
- Development of indigenous capability for technology assessment and environmental auditing for pollution prevention
- Development of indigenous design engineering capability for absorption, adaptation and improvement of imported technology through joint ventures
- Identification and rejection of manufacturing processes which result in insolvable problems of waste disposal or which carry risks which are no longer acceptable
- Identification of economies of scale of operation below which polluting industry should not be allowed
- Creation of a centralised data base on cleaner technologies to enable industry to gain access to available information facilitating pollution abatement vis-a-vis pollution control and setting national network for access to this database.
- Launching of Technology Mission on Cleaner Production (TMCP) to co-ordinate activities related to promotion of cleaner technologies on the part of Government; R & D institutions, industry associations, financial institutions, and regulatory agencies. The terms of reference for TMCP for selection, demonstration and development of projects comprise:
  - Formulation of industry specific task forces for selection of demonstration and development projects
  - Identification of cleaner technologies developed in research laboratories and R & D units in industries at bench/pilot scale which could be demonstrated
  - Identification of cleaner technolgies available abroad and facilitation of transfer and adaptation of such technologies
  - Identification of industrial units for demonstration in consultation with industry associations
  - Identification of institutions to undertake short term research for development of cleaner technolgies
  - Identification of industry sectors with residual environmental problems alongwith R & D institutions to develop appropriate low-cost solutions
  - Survey of cleaner technolgies and development related activities through site visits for assessment of the problem and bench/pilot scale studies
  - The basic criteria for selection of technologies would be the desirability, affordability, implementability and multiplicability.

Epilogue

While cleaner technologies of industrial production alongwith green products are the accepted paradigms for sustainable development, it is also essential that the western modes of life styles, characterised by consumerism, give way to limited-want philosophy.

It is essential that the western modes of life styles, characterised by consumerism, give way to limited-want philosophy.

Deliberations at the Earth Summit have clearly indicated that the debate on sustainable development has now moved on to focus on an agreement by society in general to define a sustainable lifestyle with industry producing the goods and services to maintain that lifestyle with minimum demands on the environment.

In this context, cleaner technologies of industrial production conserve resources, generate less pollution, provide direct economic benefits to the industry, and stimulate the growth of the industry as well as the national economy. However, promotion of cleaner technologies requires information, economic, legal and institutional measures that are substantially different from those used within the present legislative environmental policy framework.

Acknowledgement

The substance presented in this paper has been derived from a number of national and international publications. The authors are responsible merely for the interpretation of available literature to highlight the emerging role of cleaner technologies of industrial production in sustainable development.

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To reach the Right Conclusion:

Find the *key fact*.

Then check that one fact against each other point in your condensed statement of the problem.

If there is no direct conflict between the *thing* that *must* be done and the other factors, your decision is made.

If what you selected as the key fact *is* in opposition to one of the other points, you must weigh these two conflicting factors and decide which one must remain and which must be considered expendable.

This process will always lead you to the right conclusion. It may not be an easy or a palatable one. If it comes to a choice between two seemingly indispensable factors, it may even be a painful conclusion. But it will be "right" because it is better than any other course available to you.

Source : Charles A Cerami : How to Solve Management Problems, Englewood, Prentice Hall

Environment-Technology Linkages

S. Maudgal & M.Kakkar

The inter relationship between technological development and the environment has come into sharp focus today, as the quantum of pollutants and residues generated is directly dependent on the efficiency of the technology adopted. The paper discusses the pollution status of our industrial sector and the economic viability of waste recycling and advocates the promotion of cleaner technologies.

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All development projects use up natural resources in one form or another. Even though some of the natural resources like air and water are renewable, the others like land and minerals are finite and non-renewable. Renewable and non-renewable natural resources are of critical importance for providing a steady supply of goods and services to the society which is the primary objective of all development activities. It is essential, therefore, that the technology of the conversion process be made as efficient as possible so as to provide a much higher output of productive goods and services from the same material inputs and consequently reduce wastage that gives rise to pollutants in gaseous, liquid or solid form. This is shown schematically in Figure 1. The quantum of pollutants and residues generated is directly dependent on the conversion efficiency of the technology adopted.

Role of Technology

As such, the role of technology is to achieve more efficient conversion process for meeting the following objectives:

- Waste prevention and reduction by less consumption of raw materials.
- Modification and upgradation of the technology process for optimal utilization of natural resources
- Recycling and reuse of wastes.

The level of technology used, therefore, has a crucial bearing on both resource conservation and environment conservation. The optimal utilization of the natural resources is a pre-requisite for sustainable development which demands that the exploitation of the resources, the direction of investments, the orientation of technological development and the institutional changes should all be consistent with the future as well as the present needs of the society. The sustainable development strategy leads us directly to the carrying capacity approach:

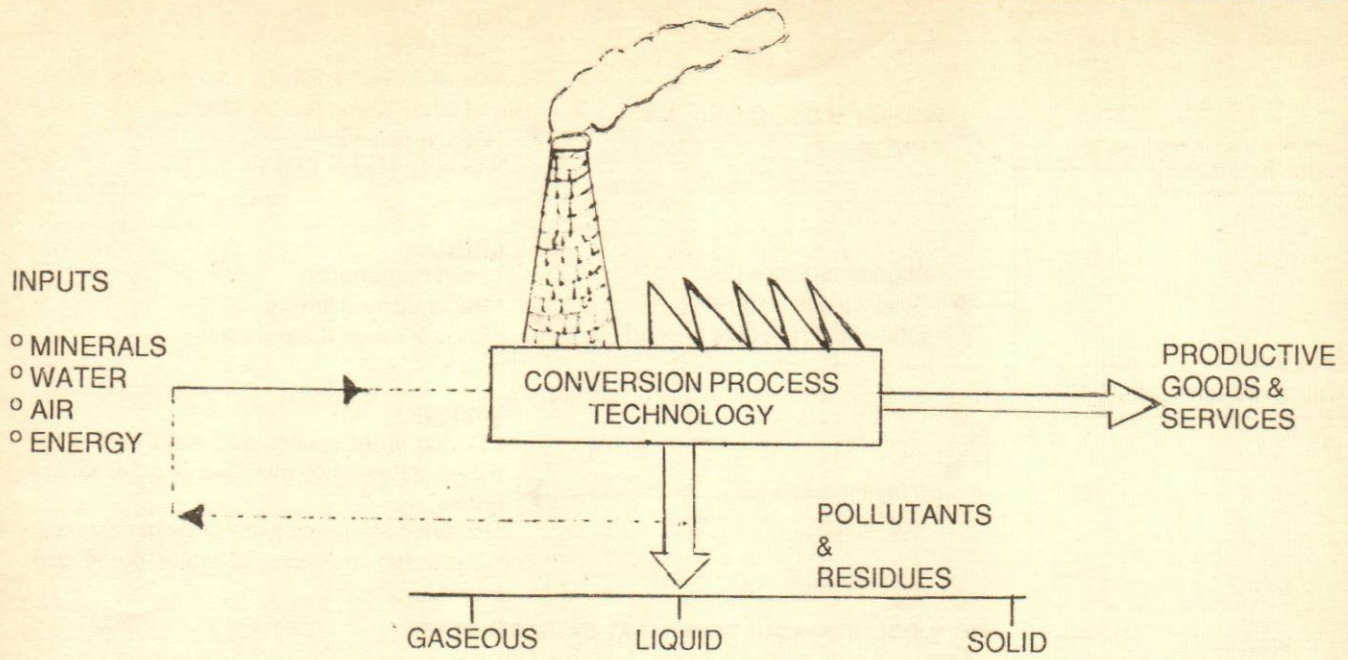

FIG. 1

"Carrying Capacity is the maximum rate of resource consumption and waste discharge that can be sustained indefinitely in a given region without progressively impairing bio-diversity and ecological integrity."

The level of technology used has a crucial bearing on both resource conservation and environment conservation.

On the other hand, most development decisions in the past seem to have been made on the basis of two criteria:

- Whether it is technically feasible; and /or
- Whether it would be economically profitable.

The question of social desirability was asked only in terms of whether the development promised to produce some immediate tangible social benefits or not. The present realisation that the development efforts may frequently produce not only the sought-for benefits but other—often unanticipated—undesirable consequences as well, seems to have been ignored, thereby resulting in avoidable wastage and pollution.

Environmental Management

The basic objective of environmental management is to maintain ecological balance by rehabilitation of the already degraded systems and by ensuring that the new development activities are so designed through suitable orientation of the policy as well as adoption of appropriate technology and management mix at the project level as to achieve the following aims:

- Optimal utilization of natural resources;
- Incorporation of suitable mitigative measures to prevent or at least offset the likely adverse environmental impacts.

Thus, the realization of the objectives of environmental management depends greatly on the technology and management package selected for a given development activity. Indeed, development and environment become two sides of the same coin.

Pollution Status in Industrial Sector

Mineral resources are a vital input to the industrial process. Mineral extraction and utilisation in various industrial units contribute pollutants which adversely affect air, water and land. This is schematically shown in Fig. 2.

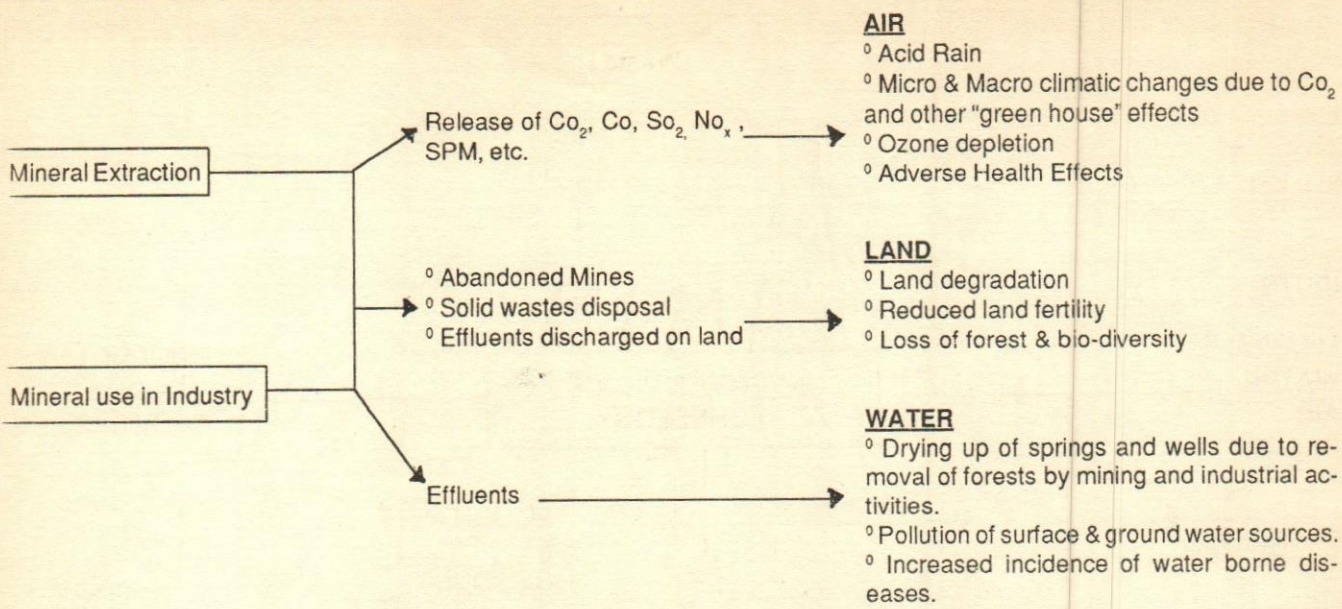

FIG. 2. POLLUTION DUE TO MINERAL EXTRACTION /USE

The realisation that the industrial units cause large-scale air and water pollution as well as degradation of land led to the formulation and implementation of emission standards by the Central and State Pollution Control Boards so as to obviate the ill effects on the health of the society. The correlation between gaseous emissions and liquid effluents from various types of industrial units and human health has been long established and has been a cause of concern to the industry because of the loss of productive man hours due to higher incidence of sickness and disability among its workers. The emission standards have been laid down for ensuring that even the cumulative effect of such emissions should not adversely affect community health. Field reality, however, is reflected in the data collected from all over the country for various types of industrial units by the Central Pollution Control Board as summarised in Table 1.

This state of affairs is a reflection of the *laissez-faire* attitude of the industry which does not realise the potential of resources wasted, which could otherwise be put to productive use, in a largely curative pollution control approach with emphasis on end of the pipe control systems. When this curative approach is non-functional, deliberately or otherwise, environmental degradation is the inevitable outcome. The main characteristics of the Policy as well as Technology Para-

Table 1: Status Of Pollution Control Compliance & Action Taken Or Proposed Upto September, 1992

Category of Industries	Total Units	No. of Units Complying with both air & water standards	No. of Units suggested for consideration of legal action	No. of units Closed
Aluminium Smelter	9	2	—	—
Copper Smelter	2	0	—	—
Zinc Smelter	4	1	—	—
Integ. Iron & Steel	7	0	—	—
Cement	124	4	1	—
Fertilizer	124	41	—	1
Oil Refinery	12	5	—	—
Petrochemical	73	2	1	—
Sulphuric acid	70	5	1	—
Thermal Power plants	79	10	3	—
Sugar	387	15	49	—
Caustic Soda	23	6	—	—
Pesticides	80	3	1	—
Distilleries	175	3	13	1
Pharmaceuticals	269	8	8	—
Pulp & Paper	80	7	—	—
Dye & Dye intermediates	65	4	—	—
Leather	93	1	2	—
Total:	1676	117 *	79	2

*Another 221 units considered for extending compliance date upto Dec., 1993 in 16 States.

Source: Central Pollution Control Board, 1992.

digms presently followed with needed switch-over in future is summarised in table 2. A reorientation in the perception of the industry is called for, through emphasis on economic returns from pollution prevention, through adoption of cleaner mode of production and reuse of wastes generated.

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Waste Recycling

Waste is a resource wasted which also becomes an environmental nuisance. This waste can however, be converted into wealth through adoption of appropriate technologies, thereby contributing to cleaning up of environment. The potential for utilisation of a few selected wastes in the industrial sector is summarised in table 3. Economic viability of recycling waste water in a few selected industries is given in table 4.

Reuse of liquid and solid wastes results in direct improvement of the environmental conditions. Selection of a suitable technology is, however, an important decision which is facilitated by ranking analysis of tech-

Table 2 : Paradigms in Policy & Technology

PRESENT	FUTURE
Policy	
° Industry OR Environment	° Industry AND Environment.
° Aggressive Approach	° Cooperative Approach.
° Economic Accountability	° Ecological Accountability.
° Environmental concerns treated as *External.*	° Environmental concerns to be *Internalised.*
° Reactive and Curative.	° Anticipatory and preventive.
° Penalties.	° Incentives.
Technology	
° End-of - pipe treatment.	° Cleaner or low polluting technology.
° Disposal of residues & wastes into the ecosystem.	° Recycle and Reuse of wastes.
° Rehabilitation & Control of damage.	° Natural Resource Conservation.

Table 3 : Waste Utilization Opportunities in Industry Sector

Sr. No.	Industrial Waste	Physical Form of Waste	Source Industry	Present Disposal Method	Potential for use
1.	Fly ash	Powder	Thermal Power Station	i. Pumped in the form of slurry to nearby low lying areas in the wet system of disposal ii. Fly ash discharged from the precipitators is conveyed for disposal to the dumps in the dry method	i. In portland pozzolana cement ii. In construction industry iii. a Dam construction b. Land reclamation c. Road construction iv. Cellular concrete v. Lime fly ash bricks vi. Sintered light weight aggregates
2.	BlastNfurnace Slag	Solid lumps	Steel Industry	Dumping in open area	i. As a component in blast furnace slag cement ii. As a component in binding material i. Road aggregate ii. Slag wool
3.	Lime sludge	Slurry Paste	Fertilizer, Sugar, Paper & Acetylene industry	Stored in large outdoor settling ponds	i. As a raw material in cement manufacture ii. In lime pozzolana mixture
4.	Chemical gypsum	Slurry/paste	Fertilizer industry	Pumped in the form of slurry to the dumping ponds	i. As a set controller in the manufacture of cement in place of mineral gypsum ii. For making gypsum block board
5.	Red mud	Paste	Aluminium industry	Dumped in open area	i. As a component of raw mix in the cement industry ii. In the manufacture of building bricks iii. Light weight structural blocks

Table 4: Benefit Cost Analysis For Selected Industries

Industry	Total Wastewater flow (m^3 /d)	Total Cost of plant (Rs. × 10^5)	Net Annual Recovery Rs. × 10^5)	Investment payback period (years)	Remarks
Apparel	6450	4625	4375	1.05	Recycle in process house
Alcohol	1725	2250	975	2.30	Reuse of energy in process house
Tanning	2710	3875	No	No	Recycle for irrigation
Food Processing	1460	10500	4250	2.47	Recycle for irrigation / process house and reuse of energy
Viscose Rayon	4500	200	36	5.5	Recovery & Reuse of Zinc, Foreign Exchange Savings

NQ: Not Quantified

* Based on analysis of some recently installed recycle and recovery systems in India.

nology options in waste management and includes the following steps:

- Identify feasible treatment processes for meeting the stipulated effluent standards as also processes that facilitate recycling and reuse.
- Estimate sizes of individual units in treatment processes.
- Estimate land, power and staff requirements for each alternative.
- Estimate capital and annual O&M costs.
- Estimate annual benefits, if any, and calculate net annualised costs.
- Identify the attributes for ranking of alternative.
- Apportion a total score of 1000 between the assessment attributes based on their importance through ranked pair-wise comparison technique.
- Develop Efficiency Index Relationships (EIR) using Delphi technique.
- Estimate actual score for each attribute for various technology alternatives using EIRs.
- Add the scores for individual alternatives to rank the alternatives.

This methodology is illustrated for waste water treatment alternatives in table 5.

Similar analysis for ranking of technology options in the manufacturing sector can be carried out for selecting an appropriate technology.

Table 5 : Ranking of Wastewater Treatment Alternatives

Attribute	Max.score	Score for Alternative					
		Activated Sludge process	Trickling Filter	Carrousel Oxidation Ditch	Stabilization ponds	Aerated Lagoon	Aerated Lagoon with Settling ponds
	P						
Environmental Risks	100	100	100	100	100	50	100
Health Risks	200	150	120	175	125	160	140
Aesthetic Risks	50	50	20	50	15	30	50
Net Annualised Cost*	250	17	30	0	140	250	175
O & M Staff Requirement	100	0	0	65	100	76	76
Land Requirement	200	193	193	200	0	194	163
Vis-a-vis availability Reliability	100	100	100	100	100	80	80
Total Score	1000	610	563	690	580	840	784
Ranking		iv	vi	iii	v	i	ii

* With resource recovery, wherever possible

Table 6 : Energy and Material Requirements for Different Steel Processes in Japan

	Process requirements per tonne of liquid steel[a]			
	BF-BOF	BF-OHF	DR-EAF	Scrap-EAF
Energy				
Fuel oil (kg)		80		26
Metallurgical Coal (kg)	730	580		
Electricity (kwh)	140	110	740	550
Natural gas (m^3)			3.8	
Total (gcal)[b]	5.9(6.1)	5.5(5.7)	3.8(5.1)	0.7(1.6)
Raw materials				
Iron ore (kg)	1,200	970	1,420	
Scrap (kg)	220	470	250	1,200

[a] BF-BOF: blast furnace plus oxygen furnace; BF-OHF: blast furnace plus open hearth furnace; DR-DAF: direct ore reduction plus electric arc furnace; Scrap - EAF: electric-arc furnace and 100% scrap.

[b] Electricity is valued on an end-use basis (0.86) Mcal/k Wh) in calculating the first total for each process. The number in parentheses values electricity on a primary basis (2.58 Mcal/k Wh).

Source: United Nations, 1991.

Illustrative Examples

Energy and raw materials are the prime movers of the industry and even marginal savings in either or both can go a long way in reducing environmental degradation and enhancing the supply of goods and services to the society from the same resource inputs. We are already facing scarcity of these resources and the supply of power is in acute shortage both on the industrial and domestic front. The examples taken here are, therefore, to illustrate the potential savings of energy and raw materials which also simultaneously demonstrate the positive impact on environment.

Energy and raw materials are the prime movers of the industry and even marginal savings in either or both can go a long way in reducing environmental degradation and enhancing the supply of goods and services.

Iron and Steel

Under the advanced technology assessment system initiated by the Centre for Science and Technology for Development, United Nations, analysis of the electricity intensity between different processes of steel making in Japan has been done as illustrated in Table 6. The Basic Oxygen Furnace (BOF) consumes about 25 per cent more electricity than an Open Hearth Furnace (OHF) per unit of output. The BOF is more energy efficient when all energy forms are considered. While the BOF process has replaced the OHF in large integrated steel mills in most of the countries of the world, some developing countries, including India, continue to employ OHF to a large extent as they are still to be phased out during the next 10-15 years.

A comparative analysis of classical (blast furnace in iron making) and new technologies (direct reduction route in iron and steel making) is as follows:

Classical route to Iron and Steel making (Blast Furnace - BOF)

- Emission of Gaseous Pollutants
- Emission of particulates
- Discharge of waste from coke oven, BF, Oxygen converter etc.
- Disposal problems due to toxic nature of wastes
- Recalcitrance of some solid wastecs for recycling/reutilisation.
- Thermal emission to air, water
- Noise pollution
- Large water consumption

Direct Reduction Route (Direct Reduction of Iron Ore & Melting of Reduced Products)

Lesser environmental impacts due to :

- Less discharge of pollutants to air and water
- Lesser amount of by-products (Slag, dust, sludge).
- Easier recycling of solid wastes (mostly iron ore and products).
- Solid waste can be recycled or dumped without risk

Table 7: Controlling pollution through improved technology for electric power generation

Fuel and Plant Type	Emissions control	Percentage abatement in relation to base case			Thermal Efficiency (percent)	Added costs as percentage of generation costs
		Particulate Matter	SO_2	No_3		
Base						
Coal, conventional boiler	None	0	0	0	34.0	-
With improvements and controls						
Coal						
Conventional boiler	Mechanical cleaning (cyclone)	90	0	0	34.0	<1
Conventional boiler	Fabric (baghouse) filters	> 99	0	0	34.0	2-4
Conventional boiler	Electrostatic precipitators (ESP)	> 99	0	0	34.0	2-4
Conventional boiler	ESP/coal cleaning	> 99	10-30	0	34.0	4-6
Conventional boiler	ESP/SO_2 controls	> 99	90	0	34.0	12-15
Conventional boiler	ESP/SO_2 And NO_2 controls	> 99	90	90	33.1	17.20
Fluidized bed combustion	ESP	> 99	90	56	33.8	
Pressurized fluidized bed combustion/combined cycle[b]	ESP	> 99	93	50	38.9	<0-2
Integrated Coal gasification/ combined cycle[b]	None	> 99	99	50	38.0	
Residual fuel oil						
Conventional boiler	None	97	30	12	35.2	
Conventional boiler	ESP/SO_2 controls	< 99.9	93	12	35.2	10-12[d]
Conventional boiler	ESP/SO_2 and NO_2 controls	> 99.9	93	90	34.4	13-15[d]
Natural gas						
Conventional boiler	None	> 99.9	> 99.9	37	35.2	
Conventional boiler	NO_2 controls	>99.9	> 99.9	45	35.2	< 0
Combined cycle [b]	None	> 99.9	> 99.9	62	44.7	

Note: SO_2 sulphur dioxide; NO_2 nitrogen oxides. Figures for coal and residual fuel oil are based on 3 per cent sulphur content.

a. In relation to base case. The percentages are based on generation costs of 5 cents per kilowatt hour. excluding transmission and distribution.
b. A combined cycle plant uses both gas and steam turbines to drive the generators. The gas turbines are powered by the hot gases emerging directly from the combustion chamber. Steam is also raised in the combustion chamber and by utilizing the still- hot exhaust gases from the gas turbines. The improvements in efficiency arise from the thermodynamic advantages of higher inlet temperatures to the heat engine (turbine).
c. Varies with relative costs of oil and coal.
d. In relation to conventional oil boiler without controls.

Sources; Based on OECD 1987; Asian Development Bank 1991

Energy

Thermal plants are the main source of power supply to the industrial sector in India and fossil fuels are likely to continue to be the back bone of the energy sector during the 21st century as well. Thermal power projects are also the main contributors of air and water pollution as well as land degradation. Options are, however, now available for reducing all significant pollutants from coal—except carbon dioxide—to lower levels per unit of output. The technological developments in the energy sectors, as reported by OECD, are summarised in table 7.

There are essentially 4 technological options for reducing harmful emissions, namely:

- Fuel switching to lower sulphur, coal, oil and gas
- Cleaning the coal before combustion
- Controlling the emissions:
- More efficient use of existing fuels by adopting high efficiency low emission technologies.

A comparative analysis shows that adoption of more efficient technologies results in added costs in the range of 2-4 per cent of generation cost compared to cost addition of 12 to 20 per cent through the use of ESPs and SO_2 /NO_x control measures.

Barriers to adoption of clean technologies

A wide range of economic and non economic barriers discourage socially desirable investment in adoption of cleaner technologies including:

- Emphasis on the minimum first cost rather than life cycle cost
- Unrealistic duties and taxes

- Adverse balance of payment (BOP) situation
- Dependence on external initiatives and resources in defining and implementing new directions for technology choices
- Shortage of efficiency oriented managers and performance oriented staff
- Weak linkages between Government and industry.

Promotion of Cleaner Technologies

Promotion of cleaner technologies calls for adoption of the following;

- Stimulation, development and use of clean technologies through environmental legislation
- Reorientation of lending policies of national and international financial institutions towards "greener credit' for financing clean technologies, retrofitting and modernisation of old units
- Extension of knowhow, through training and demonstration programmes
- Creating a network of national institutes for intensive R&D for development of clean processes and technologies
- Ensuring access to technology and finance available in industrialised nations for ensuring quick transfer of technology
- Rational pricing at full cost, including environmental damage repair cost.

One of the most effective tools for promotion of cleaner technologies is the transfer of knowhow through "demonstration projects". Development and use of clean technologies also involves a certain amount of financial risk which deters the entrepreneurs from going in for untried cleaner technologies. Since the industrial countries have a large data base derived from proven field conditions, the surest and quickest way of assimilating clean technologies is by creating access to this data and processes to all those developing countries that wish to modernise and switch over to cleaner modes of production. This would also facilitate effective implementation of the related recommendations of Agenda 21.

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□

THE CUTTING EDGE

Two men cut wood all day long. One worked straight through, without stopping to rest. At the end of the day he had a sizeable pile of logs. The other would chop for 50 minutes and then take a ten-minute break. At the end of the day he had a much larger pile.

"How could you chop more?" asked the man who worked continuously.

His friend replied, "When I stopped for rest, I also sharpened my axe."

(*Courtesy: Reader's Digest*)

Hazardous Wastes : Identification, Packaging, Labelling & Tracking

A.K. Saxena

The improper management and indiscriminate disposal of hazardous wastes in the past have had an adverse impact on human health and the ecosystem. In view of this, the Government of India has brought hazardous wastes under strict control through "Hazardous Wastes (Handling and Management) Rules, 1989" and published guidelines for their management. As per these rules, the industries generating hazardous wastes have to fulfill certain requirements for its storage, transportation, treatment and disposal. The paper deals with the identification, packaging, labelling and transportation of hazardous wastes.

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The need for hazardous waste management system begins with the generation of waste and continues through all subsequent stages of management actions to control and contain the waste involving coordination among various persons and groups. The management of hazardous wastes, led the Government of India to notify "Hazardous waste (Handling & Management) Rules, (1989). In order to implement the rules, the Ministry of Environment and Forests has brought out Guidelines for Management and Handling of Hazardous Wastes (Ministry of Environment & Forests, 1991).

Identification of Hazardous Wastes

Hazardous wastes are those that contain highly persistent elements, chemicals, and compounds having chronic and acute impact on human health and environment. They may be in the form of solids, liquids, or sludges. Hazardous wastes are generated from a wide range of industrial, commercial, agricultural and even domestic activities. Due to the inherent properties and characteristics, hazardous wastes can cause immediate short-term, public health problems and long-term environmental pollution as well.

Hazardous wastes are those that contain highly persistent elements, chemicals, and compounds having chronic and acute impact on human health and environment.

One of the major problems in hazardous waste management is the absence of universally acceptable and comprehensive definition of hazardous waste. In developing an organised approach to hazardous waste

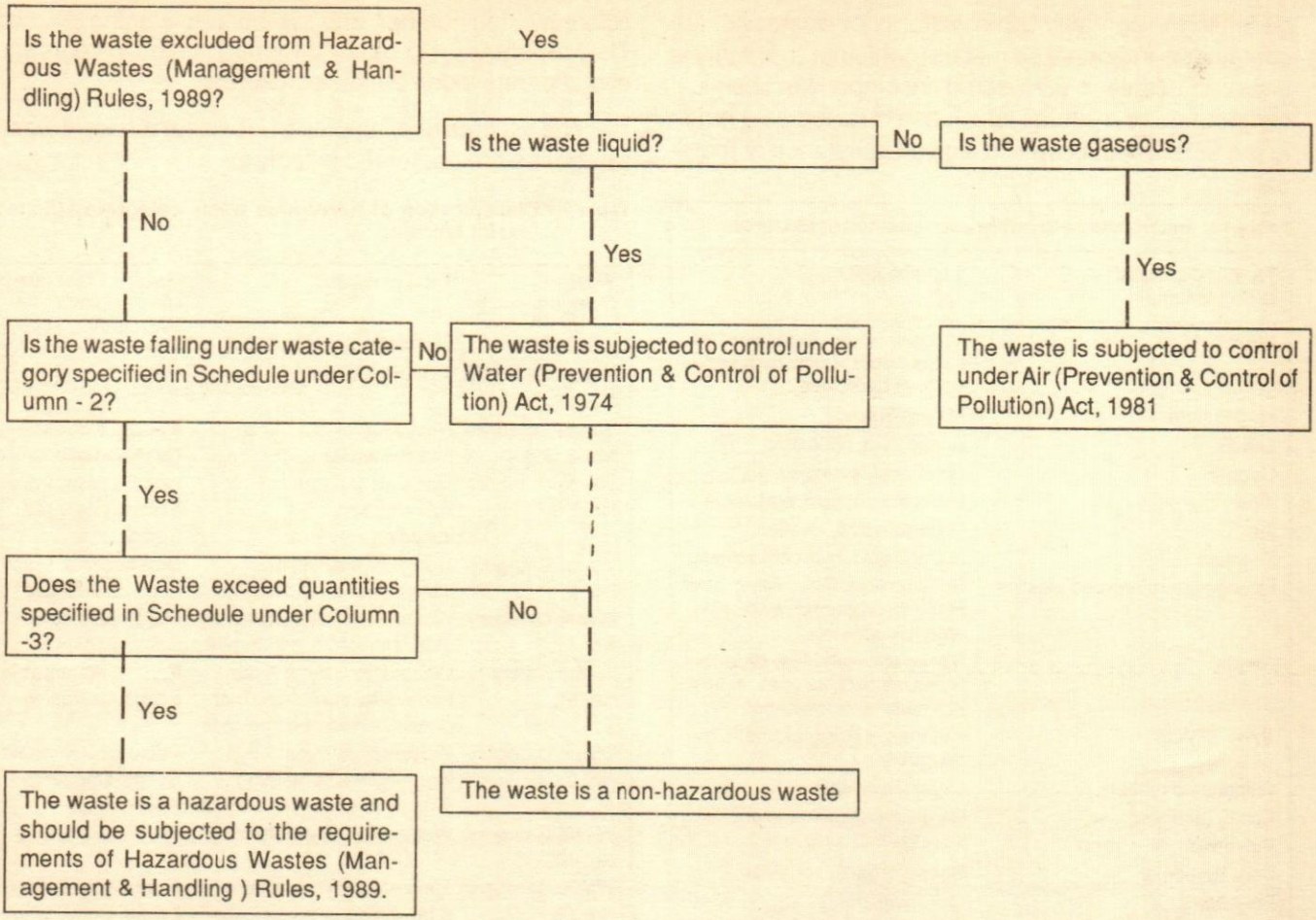


FIG. 1. DECISION CHART FOR IDENTIFICATION OF HAZARDOUS WASTE

assessment and management, a system of waste identification and classification must be formulated. In many countries, such a system forms an integral part of a legal definition of hazardous waste. In the existing regulation, the hazardous waste has not been defined properly. However in the brainstorming session of the Ministry of Environment and Forests on Hazardous Waste Management organised by the National Environmental Engineering Research Institute, Nagpur in August 1991, the following definition has been proposed for hazardous wastes:

"A hazardous waste is any substance excluding domestic and radioactive wastes which because of its quantity and/or corrosive, reactive, ignitable, toxic and infectious characteristics causes significant hazards to human health or environment when improperly treated, stored, transported or disposed" (National Environmental Engineering Research Institute, 1991). It has been proposed to include this definition in the rules.

In the existing regulations, the hazardous wastes have been classified into 18 categories as per their sources alongwith their regulatory quantities. A simplified chart for identifying hazardous waste is presented in Figure 1.

Packaging & Labelling

The type of collection and packaging material depends mainly on the chemical and physical characteristics of waste. The generator must choose the most appropriate container. Containers offer the advantages of being portable, suitable for any physical state of waste, and flexible as to means of filling. They can be kept next to the waste generating process until full, then easily moved to a centralised waste storage area. Most containers are suitable for many types of waste. Empty containers, which had contained raw material, may be suitable for storing waste. However, the use of empty containers will depend on the compatibility of waste with the container and the residues which may

be left in the container. Compatibility of waste with the container is important so that the container's integrity is impaired. Table 1 lists some incompatible chemical compounds or mixtures which can be used as a guide to predict compatibility with a given substance or material.

Table 1 : Incompatible Chemical Compounds or Mixtures

Tank or Container Lining Material	Incompatibility
Steel	Mineral acids, Aluminium alkalies, potassium hydroxide, Sodium hydroxide
Magnesium	Mineral acids
Lead	Acetic acid, nitric acid
Copper	Nitric acid, ammonia
Zinc	Hydrochloric acid, nitric acid
Tin	Organic acids, alkalies
Titanium	Sulfuric acid, hydrochloric acid
Fiberglass--reinforced plastics	Sulfuric acid 95%, Nitric acid 50%, hydrofluoric acid 40%, aromatic solvents
Alkyds	Strong mineral acids, strong alkalies, alcohol, ketones, esters, aromatic hydrocarbons
Vinyl (PVC)	Ketones, esters, aromatic hydrocarbons
Chlorinated rubbers	Organic solvents
Epoxy (amines,	Oxidising acids (nitric acid),
Polyamide, or esters)	ketones
Coal tar epoxy	Strong organic solvents
Polyesters	Oxidising acids, strong alkalies, mineral acids, ketones, aromatic hydrocarbons
Silicones	Strong mineral acids, strong alkalies, alcohols, ketones, aromatic hydrocarbons

Labelling of Container

Once the hazardous waste is collected and packed, it has to be labelled properly. First and foremost, the container should be marked with the words "HAZARDOUS WASTE" in bold capital letters. The container should also contain the following information:

- Type of waste and category no.
- Quantity of waste stored
- Prominent characteristics, and
- Date of storage

There are approximately 22 different hazard classes or types of hazards posed by hazardous materials. However, in case of hazardous wastes, where it is in the form of mixtures, their hazards can change. Therefore, the container has to be labelled with the predominant characteristic of the waste. The labels use shape, colour, written number, and symbols as warning devices. They also help the properly informed person to segregate and separate incompatible containers.

The illustrative examples of labels for different waste categories are presented in table 2.

Table 2 : Classification of hazardous waste categories (Schedule) for labelling

Waste Categories	Type of wastes	Hazard Class label (As per Motor Vehicle Act, 1988)
Waste Category No. 1	Cyanide waste	Poison
Waste Category No. 2, 3,& 4	Heavy metal bearing waste	Poison, Corrosive, Oxidising substance
Waste Category No. 5	Non-halogenated hydrocarbon including solvents	Combustible, Poison Flammable liquid, Corrosives
Waste Category No. 6	Halogenated hydrocarbon including solvents	Combustible, Poison Flammable liquid
Waste Category No. 7	Waste from paint pigment, glue, varnish, & printing inks	Flammable solids, Combustibles
Waste Category No. 8	Wastes from dyes & dye intermediate containing inorganic chemical compounds	Poison, Flammable Solids, Corrosive
Waste Category No. 9	Wastes from dyes & dye intermediate containing organic chemial compounds	Poison, Flammable Solids. Dangerous when wet.
Waste Category No. 10	Waste oil & oil emulsions	Flammable Liquid
Waste Category No. 11	Tarry waste from refining & tar residues from distillation or pyrolytic treatment	Flammable Solids/ Liquid, Combustible
Waste Category No. 12	Sluges from waste water water treatment incl. incineration ash.	Poison, Dangerous when wet
Waste category No. 13	Phenols	Poison
Waste Category No. 14	Asbestos	Poison
Waste Category No. 15	Wastes from pesticide& herbicide manufacturing and residues from formulation units	Flammable Solids/ Liquid, Poison, Combustible
Waste Category No. 16	Acid/Alkaline/Slurry Wastes	Corrosive. Oxidising substance
Waste Category No. 17	Off-specification & discarded products	Poison
Waste Category No. 18	Discarded containers & liners of hazardous & toxic chemicals & wastes	Dangerous

Tracking of Hazardous Wastes

The most common means of transportation of hazardous chemical waste is by road. Hazards associated with on and off-loading activities pose a greater risk than

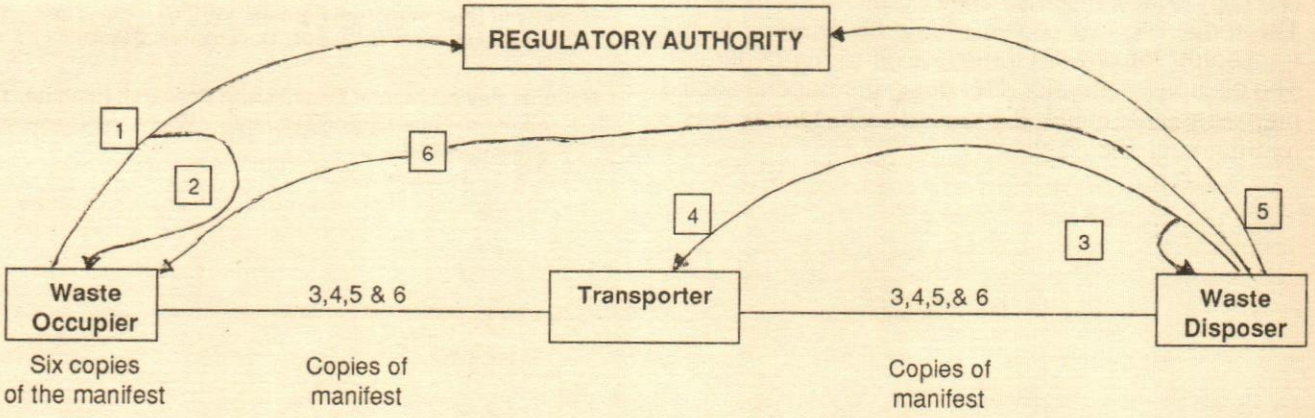
the transport itself. Provided trained drivers in reliable vehicles are employed, and waste is properly packaged, the risks to the community are small. In order to avoid risk, the following controls are desirable:

* Transportation of hazardous waste should be subject to a permit issued by the regulatory authority to contractors with approved vehicles and trained drivers
* Each vehicle carrying prescribed hazardous waste should be identified using the appropriate hazard symbols
* Each movement of waste on public roads should require a transport certificate showing its origin and destination
* The carrier must ensure that he has the necessary information on the material to be transported, and has formulated an emergency plan in the event of spillage.

Paperwork Tracking system/Trip ticket system

Many countries have adopted a paperwork tracking or manifest system to document the generation of a hazardous waste, all the later processes that it may undergo and offsite waste transportation. The paper work accompanies the waste shipment and provides a record of waste movement from the waste producer through each intermediate management stage to final treatment and disposal. The paperwork serves as a "chain of custody" document. Every time the waste shipment changes hands, the responsible persons sign the paper work. The government regulatory agency must receive a copy of the paperwork at crucial stages in the transfer to monitor the transfer.

In India, the generators, at the time of transportation of their hazardous wastes, have to prepare six copies of the manifest containing details of the waste. The first copy has to be forwarded to the concerned state Pollution Control Board by the Occupier, after signing the manifest. The second copy of the manifest is retained by the occupier and remaining copies has to be handed over to the transporter. The third copy of the manifest will be retained by the owner/operator of the facility. The owner/operator of the facility has to hand over the fourth copy to the transporter after signing the manifest. The fifth and sixth copies have to be sent to the concerned Pollution Control Board and the occupier respectively after receiving the waste. While forwarding the copy of the manifest to the regulatory agencies, the owner or operator should also indicate the proposed methods of treatment and disposal of the wastes. The concept of manifest system is shown in Figure 2.



Colour Code Specifications

Copy No. 1 — White in colour, forwarded to the Regulatory Authorities by the Occupier/Generator
Copy No. 2 — Light yellow in colour, retained by the Occupier/Generator
Copy No. 3 — Pink in colour, retained by the Facility Owner/ Operator/Site Attendant
Copy No. 4 — Dark yellow in colour, handed over to the Transporter by the Facility Owner/Operator, Site Attendant
copy No. 5 — Green in colour, forwarded to the Regulatory Authority by the Facility Owner/Operator
Copy No. 6 — Light blue in colour, returned to the Occupier by the Facility Owner/Operator.

FIG 2. COLOUR CODE SPECIFIATIONS AND MOVEMENT OF THE MANIFEST

Manifest discrepancy

Manifest discrepancies are differences between the quantity or type of hazardous waste designated on the manifest, and the quantity or type of hazardous waste, a facility actually receives. Significant discrepancies are:

- For bulk waste, variations greater than 10 percent in weight, and
- For batch waste, any variation in piece count such as a discrepancy of one drum in a truck load.
- Any difference between the characteristic of the waste mentioned in the manifest and actually received by the facility owner of operator.

Manifest discrepancies are differences between the quantity or type of hazardous waste designated on the manifest, and that actually received.

In such cases, the owner or operator should immediately reconcile the discrepancy with the transporter and/or generator. If the discrepancy cannot be resolved, the hazardous waste should be returned to the occupier/generator after noting the same on the manifest. He should retain one copy of the manifest and send one copy to the concerned State Pollution Control Board. The remaining two copies should be returned to the transporter for onward transmission to the generator. The occupier/generator after doing the needful should prepare another manifest and send the hazardous waste for treatment and disposal.

Import of Hazardous waste

Import of hazardous waste for dumping and disposal is not allowed in India under Rule - 11 of Hazardous Waste (Handling and Management) Rules, 1989. However, such waste can be imported for processing or reuse as raw material (Gazette of India, 1989). In such case, the importer and the exporter are required to take prior permission from the Ministry of Environment and Forests, Government of India, for transboundary movement of hazardous wastes. The exporter and importer should provide information on the prescribed Form - 6 of Hazardous Waste (Handling and Management) Rules, 1989 to the Central Ministry of Environment and Forests and respective State/Central Pollution Control Boards respectively. Subsequently, the Central Government or the State Pollution Control Board should inform the concerned Port Authority to take appropriate steps with respect to safe handling of the hazardous wastes at the time off-loading. In case of import of hazardous waste, the exporter becomes the generator and importer, the receiver of the waste. For proper tracking of hazardous waste, the same manifest system should be applied in such cases.

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Management of S & T: Perception of Scientists & Engineers

S. Pruthi

In order to understand the differences in perception of young and middle aged scientists and engineers about the management of science and technology, it is imperative to analyse the dynamics of the development of science and technology. Therefore, the study focuses on aspects such as norms followed by the scientific community while pursuing scientific research: intrinsic and extrinsic factors influencing the growth of science and technology and the impact of science and technology on socio economic objectives. It is generally debated whether young scientists should be associated with planning and policy making. The study lends support to the need for their involvement in these processes.

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A number of studies have been undertaken on the effect of age on motivation, job satisfaction, performance and creativity of scientists. They clearly demonstrate that age has a definite bearing on all these aspects. Important among these are the studies conducted by Herzberg, et al (1957); Hulin and Smith (1965) and Salch and Hyde (1969). Pelz and Andrews (1966) and Glazer (1966) opined that performance reaches its peak in mid age and declines during the later period of career development. Glenn (1975) and Riley (1973) showed that age and job satisfaction have positive association. Age also influences the perception of an individual. Therefore, there should be subtle differences between the perceptions of young and middle aged scientists regarding the problems of management of science and technology for the following reasons:

- Young scientists are new to the profession and yet to get socialized with the organizational environment, they behave differently from those who are experienced and have already undergone the socialization process.
- Young scientists have a more radical approach to problems faced by them than middle aged scientists.
- Young scientists are more creative than middle aged ones. This contention is borne out by the following statement of Bernard Shaw: "It is the creativity of the Young which keeps the old on toes."

The present survey was conducted with the following objectives:

* To assess the relative perceptions of young and middle aged scientists and engineers about the extent to which professional norms are being

followed by the scientific community while pursuing scientific research; to identify the factors influencing the growth of science and technology and the organizational factors other than financial resources inhibiting the growth of science; and to evaluate the impact of science and technology on socio-economic objectives at present and the likely impact in the future.

* To highlight the differences in the perceptions of young and middle aged scientists and engineers, if any.

Methodology

The paper is based on data collected during an opinion survey conducted on scientists and engineers who attended a national seminar in New Delhi in 1986. The data was collected using a structured and pre-coded questionnaire. The questionnaire was designed to secure two types of information:

* Demographic information about age, qualifications, institutions to which the scientists and engineers belong, field of specialization and the type of activity in which they are engaged.

* Perceptual information regarding norms adhered to by scientists and engineers, and their opinions regarding the factors influencing the growth of science and technology, both extrinsic and intrinsic, and the impact science and technology have had on various socio-economic objectives so far and are likely to have in the future.

Copies of the questionnaire were distributed among 800 scientists and engineers and about 450 filled-in copies were received. Ten of them were rejected due to incomplete or inconsistent information.

Sample Characteristics: About 58 per cent of the total respondents belong to universities, and 22 per cent to government research institutions. The number of respondents having affiliation to industry is small. For studying the influence of age on the perceptions of scientists and engineers, the total population is categorized into two groups.

Upto 35 years (young scientists), and

Above 35 years (middle aged scientists).

About 54 per cent of the respondents belong to the category of young scientists and engineers and 46 per cent to the middle aged category.

Findings

Norms followed by the scientific community while pursuing research: Norms are means of regulating the quality of scientific research. Merton was the first to identify a set of norms followed by the scientific community while pursuing scientific research. These norms are disinterestedness, organised skepticism, universalism and communality. However, some of these norms are not valid today because of the linkages of science with socio-economic and political systems.Figure 1 illustrates the norms followed by the scientific community. To determine the extent to which norms are related to the quality of science and the behavioural aspects of the scientific community, the scientists and engineers covered in the survey were asked to give their views on a five point scale on the following statements (5: represents agree; 4: tend to agree; 3: intermediate; 2: tend to disagree and 1: disagree; these values were recast into 5= high value; 1 = low value).

The following were the norms selected:

Indian scientists

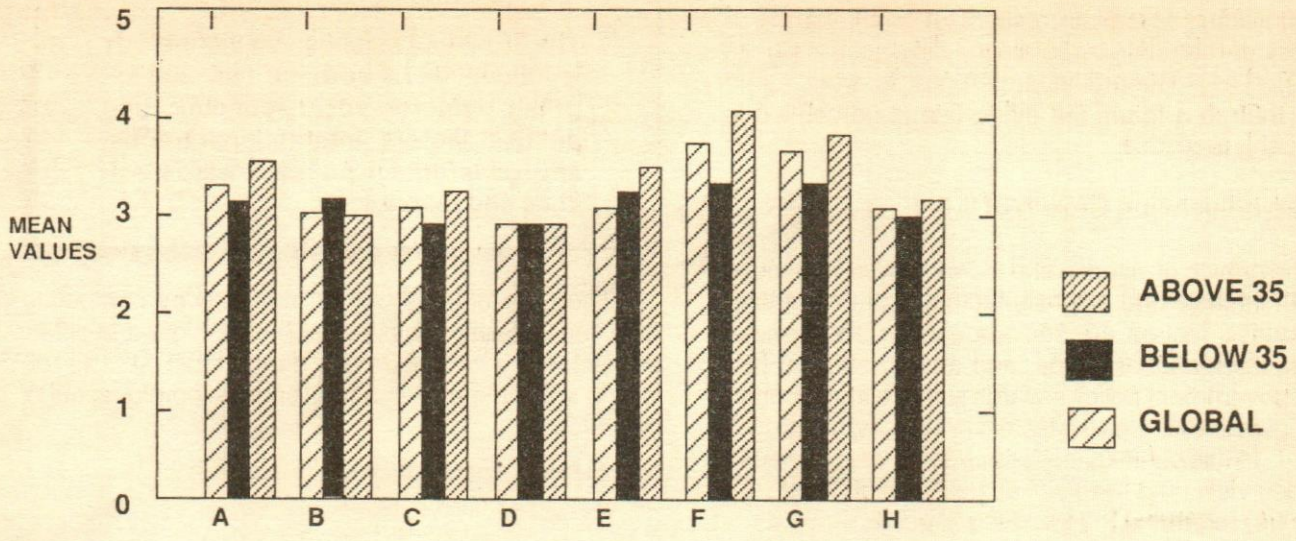
* Maintain high professional standards
* Give due credit to their junior colleagues
* Discuss their problems freely (a) within group and (b) with fellow scientists outside their institution
* Evaluate the research of fellow scientists strictly on scientific merit

Table 1 : Work norms followed by scientific community

[values represent mean scores]

Norms	Global (N=441)	Below 35 yr. (N=238)	Above 35 yr. (N=203)
Maintenance of professional standards	340	3.31	3.51*
Discussion with immediate colleagues	3.00	3.02	2.98
Discussion with colleagues outside their institutions	3.02	2.95	3.10
Giving awards to juniors	2.82	2.82	2.82
Evaluation of research work on scientific merit	2.86	2.95	3.09
Preference to work alone rather than in a team	3.42	3.20	3.68**
Do not hesitate to criticize research work in conferences	3.30	3.20	3.42
Tolerance to criticism of research work	2.83	2.82	2.84

* Significant at 1 per cent.
** Significant at 5 per cent.



NORMS

* Significant at 1 per cent (A)
** Significant at 5 per cent (F)

A-Maintenance of professional standards
B-Discussion with colleagues
C-Discussion with colleagues outside their institution
D- Giving awards to juniors
E- Evaluation of research work on scientific merit
F- Preference to work alone rather than in a team
G- Do not hesitate to criticize research work in conferences
H-Tolerance to criticism of research work

FIG. 1. WORKS NORMS FOLLOWED BY SCIENTIFIC COMMUNITY (VALUES REPRESENT MEAN SCORES)

* Prefer to work alone rather than in a team
* Do not hesitate to criticize one another's work in seminars and conferences and
* Have tolerance to criticism on research work.

Scores assigned to various norms by the respondents were analysed by computing mean scores. The results of this analysis are presented in Table 1. Some of the important findings emerging out of this analysis are:

* Respondents agree that Indian scientists and engineers maintain professional standards with regard to authenticity and validity of data and its interpretation, and do not hesitate to criticise one another's research work in seminars and conferences.
* There is difference of opinion on the points that scientists/engineers are known for giving due credit to junior colleagues, for being tolerant to criticism on research work and for evaluating research work of their fellow workers strictly on merit.
* Though emphasis on interdisciplinary research was initiated about a decade ago, and the concept of mission-oriented research was introduced about two years ago, the respondents agree that Indian scientists prefer to work alone rather than in a team.
* As regards the influence of age on various norms, in comparison to younger scientists, middle aged scientists have given greater importance to norms, such as maintenance of professional standards with regard to authenticity, validity and interpretation of data; discussion with scientists outside the institute; preference to work alone rather than in a team, having no hesitation in criticizing research work in conferences and seminars, and being tolerant to criticism.

Young scientists have given greater importance to free discussion with immediate colleagues and evaluation of research work on scientific merit. However, the same importance is given by both groups to giving due credit to junior colleagues. Differences between the perceptions of young and middle aged scientists are

not significant, except in respect of maintenance of professional standards wherein the difference is significant ($p<0.01$). Regarding preference to work alone rather than in a team, the difference in perception is significant, ($p<0.05$).

Factors Influencing Growth of S & T

The growth of science and technology is influenced by both intrinsic and extrinsic factors. Notable among the extrinsic factors are socio-economic and political factors, international trends; and among intrinsic factors is government policy towards science and technology. Figure 2 illustrates the factors influencing the growth of S & T. In this context, the respondents were asked to give their view on a five point scale (5 = high value; 1 = low value) regarding the following aspects:

- Government support/commitment to science and technology
- Increase in scientific and technological activity at international level
- Desire to compete with other countries
- Availability of S&T manpower
- Recognition given by scientists to the role of S&T in socio-economic development.

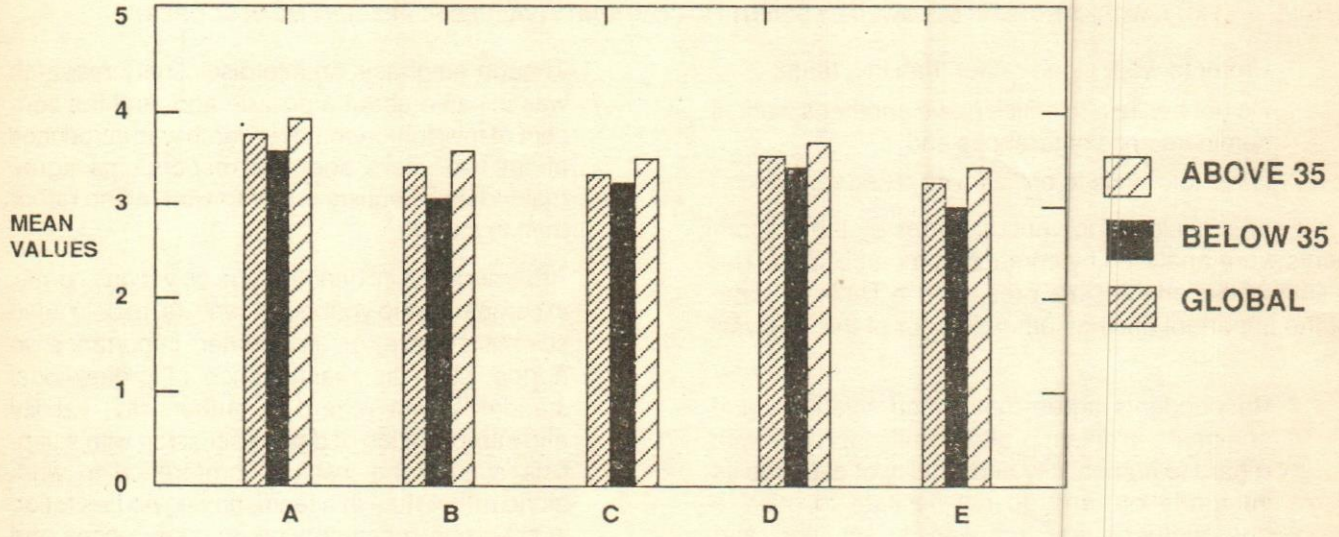
The growth of science and technology is influenced by both intrinsic and extrinsic factors—socio-economic and political factors, international trends, and government policy towards science and technology.

The data obtained were analysed by computing mean scores on the basis of scores assigned to different factors by various respondents (table 2). The following are some of the general findings emerging out of this analysis:

Table 2 : Factors governing Growth of S&T in India

(Values represent mean scores)

Factors	Global	Below 35 yr.	Above 35 yr.
Government support/ commitment to S&T	3.66	3.60	3.74
Increase in scientific activity at international level	3.39	3.04	3.49
Desire to compete with other countries	3.32	3.27	3.37
Availability of scientific and technical manpower	3.55	3.52	3.59
Role at S&T in socio-economic development	3.12	3.04	3.21



A-Government support/commitment to science and technology
B-Increase in scientific activity at international level
C-Desire to compete with other activities
D-Availability of scientific and technical manpower
E-Role of S&T in socio-economic development

FIG.2. FACTORS GOVERNING GROWTH OF S & T (VALUES REPRESENT MEAN SCORES)

* Young as well as middle aged scientists agree that all the factors, namely, government support/ commitment to science and technology, increase in scientific activity at international level, desire to compete with other countries, availability of S&T manpower, and recognition given by scientists to the role of S&T in socio-economic development, have influenced the growth of science and technology. However, least importance is given to recognition given by scientists to the role of S&T in socio-economic development. Greater importance is given to various factors by middle aged scientists in comparison to young scientists. However, the difference in perceptions of young and middle aged scientists is not significant in respect of all the factors.

Factors Inhibiting Progress

Apart from constraints of financial resources, a number of organizational factors which hinder the progress of scientific research have been identified by various science administrators, planners and policy makers. These factors arise from the wrong set of rules and regulations followed by various science and technology organizations for regulating the day-to-day activities of the scientists[1]. Insufficient availability of professional opportunities and inadequate planning are some of the constraints experienced.. To get the opinion of scientists and engineers in this connection, the respondents were provided with a list of the following 11 factors.

Lack of cooperation
Lack of career development facilities
Insufficient professional contacts
Inadequacy of planning
Bureaucracy
Inadequacy of leadership
Internal politics of the institute
Inadequate linkages with users
Lack of commitment
Lack of scientific temper and
Lack of accountability.

Preferences ticked by the participants were analysed using ORLOWSKI technique. The results of this analysis are presented in table 3. The major findings emerging from this analysis are as follows:

Table 3 : Organisational factors inhibiting Growth of S & T

Rank	Below 35 yrs.	Above 35 yrs.
I	Internal politics of the institute	Bureaucracy
II	Lack of career development	Internal politics of Institute
III	Lack of cooperation	Lack of career development
IV	Bureaucracy	Lack of cooperation
V	Inadequacy in planning	Inadequacy in planning
Absolute Coherence	0.33	0.36

* Young scientists have given first rank to internal politics of the institute, while middle aged scientists chose bureaucracy.
* Second rank is given to lack of career development facilities by young scientists and to internal politics of the institute by middle aged scientists.
* Third rank is given to lack of cooperation by young scientists and to lack of career development facilities by middle aged scientists.
* The first three factors cited by middle aged scientists and the total population are the same.
* Lack of accountability is given the least importance by both the groups.

Impact of S&T

The role of S&T in socio-economic development is universally recognized. With institutionalisation and professionalization of science and technology, demand for science and technology on the resources and demand on S&T by the society are increasing day by day. Though a viable infrastructure for science and technology has come into existence, Indian science and technology have not been able to contribute to the socio-economic development of the country to the desired extent. Various strategies have been suggested to make R & D programmes more relevant to the socio-economic needs of the nation. One of the measures suggested is to identify socio-economic objectives wherein science and technology have made a major impact so far and those in respect of which S&T should do so in the future. Accordingly, corrective measures could be taken at the planning stage, so that desired socio-economic objectives could be achieved. To know the perception of respondents regarding this aspect, they were provided with a list of eleven socio-economic

1. Procedures followed for recruitment of manpower, purchase of equipments etc. are very time consuming. The consequent delay in these procedures results in the escalation of projects both in terms of time and money, sometimes rendering the projects irrelevant.

objectives and requested to indicate the five most important socio-economic objectives in which science and technology have made a major impact so far and are likely to make in the future.

* Exploration and resource assessment of earth, seas, air, including space research
* Development of agriculture and forestry, including fisheries
* Promotion of industrial development
* Production and conservation of energy
* Development of transport/communication
* Development of educations services.
* Development of health services
* Social development
* Protection of environment
* General advancement of knowledge
* National security

The preferences of the respondents were analysed using ORLWSKI technique. The results of the analysis are presented in table 4. The first four preferences were the same for both young and middle aged scientists for the present as well as for the future. These are; development of agriculture; exploration and resource assessment of earth, seas and air; industrial development; and development of educational services. Young scientists have given third rank to protection of environment in the present and both young and middle aged scientists have assigned fifth rank to protection of environment in the future. Responses of middle aged scientists regarding the impact of science and technology show greater unanimity than those of young scientists regarding the impact in the future.

Conclusions

Analysis of the perceptions of young and middle aged scientists and engineers regarding the norms followed while pursuing scientific research reveals that both the groups agree that Indian scientists and engineers maintain professional standards with regard to authenticity and validity of data and they do not hesitate to criticize one another's research work in seminars and conferences; however, there is disagreement on the issues of giving due credit to junior colleagues, being tolerant to criticism on research work, and evaluating research work of their colleagues strictly on scientific merit. It is difficult to understand how one can be expected to do high quality research without adhering to norms, particularly evaluation of fellow workers' work strictly on the basis of scientific merit. It would be in the interest of the entire scientific community if this norm is adhered to rigorously. On the one hand, they feel that Indian scientists discuss research work freely, on the other they believe that Indian scientists and engineers are not tolerant to criticism of their research. These two view points cannot go together and if it is so, this contradiction is not healthy for doing high quality research. For keeping the tempo of high scientific research, it is necessary that inputs of new ideas are encouraged which cannot be achieved unless the scientific community gives due credit to the work of juniors.

Table 4: Impact of S & T on Socio-Economic objectives

	Present		Future	
Rank	Below 35 yrs.	Above 35 yrs.	Below 35 yrs.	Above 35 yrs.
I	Agricultural development	Agricultural development	Agricultural development	Agricultural development
II	Exploration & Resource assessment, industrial development	Exploration & resource assessment	Exploration & resource assessment	Exploration & resource assessment
III	Protection of environment	Industrial development	Industrial development	Development of education
IV	Development of educational services	Development of educational services	Development of educational services	Industrial development
V	Development of health services	Advanced knowledge, national security	Protection of environment	Protection of environment
Absolute coherence	0.33	0.36	0.29	0.28

The concept of interdisciplinary research in scientific research was introduced in India about a decade ago in the form of the All India Coordinated Projects (AICPS) in various science organisations. Recently, emphasis on interdisciplinary research was reiterated through the introduction by the Government of India of the concept of mission-oriented scientific and technological research. In spite of this, the respondents agree that Indian scientists prefer to work alone rather than in a team, which is not conducive to interdisciplinary research. This lacuna needs to be taken note of in view of the increasing complexity of the societal problems which cannot be covered in the domain of any single discipline. The science planners, policy makers and science managers should be concerned with these responses.

India has developed viable infrastructure for science and technology which would not have been possible without the Government's support, with industry being by and large a passive actor on the Indian science and technology scene. The availability of scientific and technological manpower is the second most important factor. This may be because one of the objectives of our earlier plans was to generate employment. As expected, the least importance was given to the recognition by the respondents of the role of S&T in socio-economic development.

Financial resources are always scarce in developing countries. In addition, there are other specific organizational factors which inhibit the progress of scientific research. The five most important factors are; Institutional politics; bureaucracy, lack of career development facilities and lack of cooperation and inadequate planning. Citation of institutional politics by respondents as a major factor in hampering the progress of scientific research indicates that organisations concerned with S & T are not able to take rational and objective decisions. One can cite multiply reasons for this: interference of politicians in scientific affairs, lack/inadequacy of a data base for decision making, evaluation of scientific works on extra-scientific criteria, etc. Bureaucracy also has an important role because a large number of science organisations are managed by administrators. Generally technocrats heading these organisations go by the decisions suggested by administrators in order to avoid organizational conflicts. Lack of career development facilities means that facilities/opportunities for overcoming the problems of obsolescence and upgrading of scientific knowledge are not available to the scientists and engineers especially to these who are at junior and middle levels. The science managers should be concerned with these responses. However, it is surprising to note that the scientists and engineers have given least importance to lack of accountability. It may be that they considered accountability at par with curtailing of their autonomy and freedom.

The responses regarding the impact of S&T on socio-economic objectives are on the expected lines and this is in tune with some of our crucial problems. Finally, the perception of young scientists in respect of the issues discussed above is similar to that of middle aged scientists, the differences being marginal. It is generally debated whether young scientists should be associated with planning and policy making. The present study lends support to the need for their involvement in these processes.

Acknowledgement

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Scientists & Their Job : A Case study From India

Sunil K. Dhawan & Santanu Roy

The paper ascertains aspects which are regarded as important by Indian scientists in their jobs. The sample was drawn from scientists in a government-funded research laboratory who attended a Workshop on 'Quality of Work Life' during May, 1990. Factor analysis with Vari-Max rotation revealed five factors important for Indian scientists. These are comfort, challenge, pay, relation with co-workers, and resources. Except for the factors—challenge and relations with co-workers, the satisfaction level on other factors was found to be average. It was also found that scientists who have started their career in the laboratory itself are less satisfied with their jobs compared to those who came from other organisations.

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The question, "What Indian scientists want out of their job?" has been answered largely in terms of generalities such as scientific temper, scientific culture, ethos, ethics etc. The motivational orientations of scientists toward their jobs can be adequately described by a limited number of terms like "intrinsic orientation", "economic orientation", and so on.

Herzberg et al (1957) identified six factors as having emerged in several previous factor analytic studies of job satisfaction: general satisfaction and morale, attitude towards immediate head, attitude towards satisfaction of aspirations, attitude towards the organization and its policies, satisfaction with intrinsic aspects of the job, and satisfaction with conditions of the present job. Vroom's (1964) review suggested that seven factors of job satisfaction might exist : attitude towards the organization and its management, attitude towards promotional opportunities, attitude towards job content, attitude towards supervision, attitude towards financial rewards, attitude towards working conditions, and attitude towards co-workers. In a more critical work of the previous factor analytic studies on job satisfaction prior to their development of new job satisfaction measures, Smith, Kendall, and Hulin (1969) concluded, "The factors which seem to emerge most consistently are a general factor, a pay and material-rewards factor, a factor dealing with the work itself, a supervision factor, and a factor related to the other workers on the job."

Scientists at all levels have to work in a horizontally decentralized operation, in which people outside a unit participate in its decision-making (Kiesler, 1983). This means that scientists or managers should spend more time in interacting with one another and less in directing their junior colleagues. Helfgott (1987) pointed out that the organization structure is becoming flatter with few layers between the top and the bottom. As a result thereof, the ethos of management should also shift from

the traditional emphasis on the scalar chain to a more open, organic style of management. Further, Nadler and Robinson (1983) suggested that employee involvement and expansion of the scope of their jobs are becoming increasingly important because highly automated organizations have a growing amount of integration and coordination at lower levels, pushing decision-making downward.

The ethos of management should shift from the traditional emphasis on the scalar chain to a more open, organic style of management.

Job description is equally important for better performance. This should include : job status, position title, supervision received and exercised, job summary, career mobility etc. (Delapa, 1988). Better understanding of jobs will lead to improved communication channels (Petty et al, 1989).

Newson (1990), also highlighted that to increase employees productivity, managers must know what factors motivate them. He advocated the use of the Expectancy theory which can improve motivation if nine aspects are met: capacity, confidence, challenge, criteria, credibility, consistency, compensation, cost, and communication. These aspects should be properly exercised for better results from the members of an organization.

Coming to the Indian situation, Parthasarathy (1987) makes a perceptive observation regarding the changes that followed independence which affected most organizations. He comments "The fear of authority and control is fast disappearing." A number of other studies on motivation have revealed that employees look for many other incentives in the job, other than material rewards. Narain (1973), Sinha, (1973), Moule & Ganguli, (1965), Ganguly, (1974) and Menon (1989) argued that they are unable to test their skills and make use of their experiences. Further, they perceive that their jobs do not allow them sufficient freedom to take decisions. Menon & Shamanna (1990) have indicated that the inter-personal relationships that prevail within an organization are influenced by the nature of the work flow in that organization. Other studies on socio-technical system have indicated that the technical system can affect interpersonal factors such as cooperation, communication and influence in a work situation (Meissner, 1969). Interpersonal relationships can affect productivity and this can modify the satisfaction an employee derives from his job. A report published in The Statesman, August 15, 1990 highlights that personality clashes are the root causes of conflicts in Indian scientific establishments, and "personal factors rather than technical concerns" dominate decision-making in science.

The studies related to job satisfaction indicate that there was not a great deal of empirical agreernent as to what are the basic dimensions of job satisfaction. This is particularly true for the scientific community in developing countries including India. Thus, faced both with an absence of reliable factor analytic studies of scientists' importance rating and with a large, yet inconclusive and often contradictory array of factory analytic studies of j .b-satisfaction ratings, the present study was compelled to fall back upon its own factor analysis of scientists' importance ratings.

Sample

Data were collected from about 60 scientists who attended a workshop on 'Quality of Work Life' organised by the authors during May 1990. The sample represented various levels and different divisions of a research laboratory run by government funding.

Measures

Analysis was performed on scientists' ratings on twenty-five facets of jobs in terms of how important each facet was to the scientist in his job. The twenty-five items were taken from a study carried out by Quinn and Cobb Jr. (1971). Factor analysis with Vari-max rotation was used to identify the factor loading; five factors emerged from the analysis. These factors were then compared with the background data of the respondents. Finally, mean and standard deviations were calculated to examine the degree of satisfaction/dis-satisfaction of the respondents with the five factors. Figure I illustrates the job facets of these five factors.

Results

Table 1(a) presents the background information of the respondents. Most of the scientists who had participated in the study are middle-aged and are fairly well-experienced in service. Majority of the scientists had spent their entire career within the laboratory itself. We are, therefore, dealing with a sample whose perception on various issues facing them within and outside their work place reflects their work climate and their immediate social environment.

(F1) COMFORT	(F2) CHALLENGE	(F3) PAY	(F4) RELATIONS WITH CO-WORKERS	(F5) RESOURCES
1. I have enough time to get the job done	1. The work is interesting	1. The pay is good	1. My co-workers are friendly and helpful	1. I receive enough help and equipment to get the job done
2. The hours are good	2. I have enough authority to do my job	2. The job security is good	2. I am given a lot of chances to make friends	2. I have enough information to get the job done
3. Travel to and from work is convenient	3. I have an opportunity to develop my special abilities	3. The fringe benefits are good		3. My responsibilities are clearly defined
4. Physical surroundings are pleasant	4. I can see the results of my work	4. The chances for promotion are good		4. My supervisor is competent in doing his job
5. I am free from conflicting demands that other people make of me	5. I am given the chance to do the things I do best			
6. I can forget about my personal problems	6. I am given a lot of freedom to decide how I do my work			
7. I am not asked to do excessive amounts of work	7. The problems I am asked to solve are hard enough			
8. My supervisor is very concerned about the welfare of those under him				

FIG. 1 JOB FACETS OF THE FIVE FACTORS

Table 1(a) : Background Information of the Respondents

	Mean	SD
Age	40.85	8.44
Total Length of Service	17.43	9.22
Length of Service in Organization	16.62	8.98

Table 1(b) : Background Information of the Respondents in Two Separate Groups

(a) T = S — means scientists who have started their career in the laboratory itself.

(b) T # S — means scientists who did not start their career in this laboratory.

	T = S		T # S	
	Mean	SD	Mean	SD
Age	39.65	7.76	43.11	9.18
Level	1.53	0.05	1.33	0.47

Table 1(b) presents the background information of the respondents grouped into two different categories—those scientists who have started their career in the laboratory itself (T=S) and those scientists who do not belong to this category (T#S) and classified age-wise and level-wise. People in the latter category i.e. those who had not started their career in the laboratory itself are found to be slightly older in age compared to the scientists in the former category, though they are at a slightly lower level.

Figure 1 presents the results of the factor analysis. Reliability of the factors was tested and was found to be high on split-half method. The five elliptical orbits represent the five factors—comfort, challenge, pay, relation with co-workers and resources. That these orbits are not completely independent and are partially overlapping one another signifies that a few of the issues which comprise a particular factor also influence other factors, though to a much smaller extent. The issues which make up each of these factors have also been listed.

The different factors are defined as follows. Factor 1, the 'comfort' factor, describes a scientist's desire for a job which provides solid creature comfort and which presents no problems for him. There is no indication that a scientist endorsing the items on this factor wishes his job to be exciting, interesting, or challenging—only serene and easy—in short, a 'soft' job. Factor 2 'challenge' reflects the scientist's desire to be stimulated and challenged by his job and to be able to exercise his acquired expertise and skills in his work. This factor corresponds to what in other factor analytic studies of job satisfaction has been identified as a 'type of work' factor. Factors 1 and 2 , viewed in opposition to each other, correspond in some degree to the conceptual distinction between

extrinsic and intrinsic sources of job satisfaction. The challenge factor is certainly akin to intrinsic satisfaction, comfort, however is not another name for extrinsic satisfaction, since it excludes such matters as pay, fringe benefits, and job security—all of which are traditionally regarded as extrinsic characteristics. Pay, fringe benefits, and job security comprise factor 3, the pay factor which is orthogonal to the comfort factor. Factor 4 contains only two items, both of which concern relations with co-workers. This factor has appeared frequently in factor analysis of job satisfaction in other studies. The fifth and final factor, 'resource' represents scientist's wish for adequate resources with which to do the job well—help, equipment, information, and competent supervisors.

Table 2 : Responses to the Five Factors of Job Satisfaction

Factor	Mean	SD
Comfort	3.37	0.05
Challenge	3.58	0.79
Pay	3.25	0.73
Relations with Co-Workers	3.90	0.59
Resources	3.34	0.74

Table 2 presents responses to the five factors of job satisfaction. Out of the five factors, responses to 'relations with co-workers' is most powerful. It signifies that the scientists are happy to work with their colleagues and this means that their satisfaction with their work groups is fairly high. In the previous studies "Scientists' Perception on Work Climate, Value System and Sources of Mental Energy" (1989), the authors had found a similar response—satisfaction levels of the scientists with their group-related variables like motivation to achieve objectives and confidence and trust among group members were found to be much higher than their scoring on organization-related variables. Thus, scientists exhibit a great deal of team spirit and are highly motivated to achieve objectives and have sufficient amount of confidence and trust in their team members. In the same study, while analysing the value system of scientists, it was found that co-workers had received a high priority in the factor 'groups of people'.

Response to the challenge factor has also been on the higher side. This is in line with the attitude of scientists who are working on innovative ideas and projects towards factors like challenge, initiative, creativity etc. In the study by the authors mentioned earlier, a few of the personal goals like success, achievement, creativity and dignity were rated high in importance. These are in conformity with the scientist's perception of himself as a creative individual.

Personal goals like success, achievement, creativity and dignity were rated high in importance.

However, closely following challenge, the comfort factor has also been rated high by the respondents. Scientific community forms a part of a larger society, and is perhaps not immune to societal aspirations and values. The pay factor has received average rating, which goes well with the perception that the scientists are neither paid too well nor too badly, and that the scientists themselves have taken it in their stride and are not unduly worried about it. What is of concern is the fact that the resources factor has also received an average rating. Are the resources available just about adequate to meet the routine requirements of the laboratory? If this is indeed the case, it could undermine scientific productivity, especially in the frontier areas of research.

Table 3 : Factors of Job Satisfaction Vs T=S/T#S

	T = S		T # S	
	Mean	SD	Mean	SD
Comfort	3.05	0.47	3.72	0.53
Challenge	3.61	0.79	3.54	0.78
Pay	3.29	0.74	3.28	0.72
Relation with Co-Workers	3.94	0.59	3.83	0.58
Resources	3.34	0.65	3.33	0.88

Table 3 presents responses to the five factors of job satisfaction but this time for two groups of scientists separately—those who have started their career in the laboratory itself and those who have not. The results here are similar to that of Table 2 in so far as overall responses to the factors are concerned. Relation with co-workers still commands highest rating followed by challenge, comfort, resources and pay in that order. Even the two groups of scientists display a similar set of ratings except for the comfort factor. Average rating for comfort has been given by scientists who had started their career in the laboratory itself whereas high rating has been given by scientists belonging to the other category.

Table 4 : Background Data Vs Factors of Job Satisfaction

	Age	Total Service	Service in Laboratory
Comfort	0.18	0.28	0.19
Challenge	0.23	0.35*	0.43*
Pay	0.43*	0.35*	0.31*
Relation with Co-Workers	0.01	0.02	0.25
Resources	0.29*	0.44*	0.33*

* $P < 0.05$

Table 4 presents Pearson Correlation coefficients between background data of the respondents and the five factors of job satisfaction. Interestingly, perceptions on pay and resources are found to significantly increase with age, total length of service and service in the organisation and perception on challenge is found to significantly increase with total length of service and service in the organization. It appears that though resource endowment has not been perceived as too great just as in the case of pay, with increase in age and long years of stay in the organization, they get accustomed to the situation as it is, and are converging to the set culture of the organization. At the same time, the organization seems to be offering more opportunities to the scientists to work on challenging assignments and projects. To probe into the matter in greater depth, Pearson correlation coefficients wee calculated between age and the five factors, grouped separately into two categories—for scientists who had started their career in the laboratory itself (T = S) and for other scientists (T # S) and the results are presented in Table 5. Satisfaction level with pay is found to increase significantly with age for scientists who had started their career in the laboratory itself. Pay scale of the R & D organization in question compares favorably with those in other central government organizations, and the scientists are not unduly concerned about it. For scientists who have not started their career in the laboratory itself, their perceived satisfaction with comfort, challenge, relations with co-workers and resources is found to increase significantly with age.

Table 5: Age Vs Five Factors of Job Satisfaction

Factors	T = S Age	T # S Age
Comfort	0.13	0.51*
Challenge	0.05	0.55
Pay	0.43*	0.29
Relations with Co-workers	−0.06	0.41*
Resources	0.29	0.38*

* $P < 0.05$

Discussion

The pivotal factor analysis, based upon data obtained from 60 scientists indicated that the twenty five facets of jobs that had been rated by scientists in terms of their importance to them could be represented adequately by five dimensions. The five orthogonal factors that emerged in this analysis were readily interpretable and were provisionally designated as referring to comfort, challenge, financial rewards, relations with co-workers, and resources.

The number and content of the factors identified in this study differed in several respects from that reported in previous factor analytic studies. Several theories view work related motivation or satisfaction in terms of dichotomies; perhaps an overly literal application of any of these discussions or "two factor" approaches to the present study's factor analysis might have predicted that the analysis would have uncovered only two factors corresponding to the terms of the dichotomy. Instead, the analysis disclosed five factors. The present study was not alone in this regard, since previous factor analytic studies of job satisfaction have never, to the best of our knowledge, yielded any such neat "two-factor" brace of dimension corresponding to the two terms of any of these dichotomies. Nor should any factor analysis be expected to do so. These dichotomies, at times it is argued, correspond to "higher-order" levels of organization of work motivation and job satisfaction. The existence of, or at least the conceptual utility of, such dichotomous principles does not, according to some, require justification through factor analytic techniques.

Several points of correspondence were nevertheless recognizable between the importance factors identified in this study and those identified in previous factor analytic studies of job satisfaction. The clearest replication of previously identified factors occurred with reference to this study's financial rewards factor, the factors most successfully repeated from previous studies appeared to have been those concerning opportunities for advancement and attitudes toward supervision. Since only one question about promotional opportunities was asked in the present study, the emergence of a promotional opportunities factor was unlikely, and it did in fact fail to appear in the analysis of importance ratings. Herzberg et al (1957), Vroom (1964) and Smith et al (1969) also reported the existence of factors that they described respectively as "satisfaction with intrinsic aspects of the job", attitudes toward job content", and "attitudes concerning the work itself". The challenge

factor was clearly in the same category as these factors. At the same time, both the comfort and resources factors (especially the latter) also touched upon aspects of "the work itself".

Conclusion

There exists hardly any study which has focussed on job satisfaction of research scientists working in government funded laboratories. Some work in this direction has been carried out by Menon and late Nitish R.De, but their efforts were also centered around industrial and allied sectors. The findings reported here have presented several unique features of research laboratories and people working in them. At this stage, we do not wish to go in for generalisation nor should this study be taken as representing the situation prevailing among scientific community. It is a pioneering work which opens up a new area with scope for further research that should be considered before talking about scientific temper, ethos or culture.

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Improving the Effectiveness of Indian R&D Groups

V.S.R. Krishnaiah

The paper identifies and assesses the importance of numerous structural, social and organizational factors which influence the effectiveness of R & D groups as well as the response of research groups to the goals and purposes they are supposed to serve. The effectiveness of R & D groups has been measured in terms of the goal attainment model. The important predictor variables that explain significant variance in the effectiveness of R & D groups, were found out. The results reveal that the determinants of effectiveness of R & D groups vary with the nature of goals they pursue.

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India realised at the dawn of her independence that the goal of raising the living standards of the people, can be achieved only by promoting science and technology. Since independence, the Government invested large resources in scientific and technological research. In 1958, the Indian Parliament passed the Scientific Policy Resolution to promote science. As observed by Rahman (1984), the Scientific Policy Resolution was a statement of faith as well as a commitment to science and technology; to use S & T for peaceful purposes, for the development of the country, to meet the needs of people, to provide better facilities, amenities and opportunities for their cultural development, and to promote their creative abilities. It also enunciated the steps to be taken to achieve the goals set for the country.

The Technology Policy Statement which covers a whole range of issues relating to technology, was announced by the Government in January, 1983. The basic objectives of the Technology Policy Statement are the development of indigenous technology and efficient absorption and adaptation of imported technology appropriate to national priorities and resources.

As a result of four decades of planning, the Science Policy Resolution and the Technology Policy Statement, India has a strong agricultural and industrial base. The range and sophistication of research problems being tackled in the country have made a quantum jump. Indian scientists are now engaged in some of the frontier areas of science and technology, using state of art equipment and techniques. However, the potential of Indian science and technology for contributing to the objectives of modernization and development is far greater than has been realised in the past.

While nations have become more sensitive to the societal utilisation of science and technology, the governments have to reckon with the fact that they could only afford to direct a limited part of their resources to scientific and technological research. The institutionali-

zation of scientific research and the tremendous increase in its scale of operation, have made State finance imperative. This, alongwith the availability of choices, has made it necessary that all scientific research be evaluated by the state and the people (Bhargava, 1988). In the last two decades, the speed and success of R&D's response to the various socio-economic challenges and the rate of practical application of the research results have been under scrutiny. Both these factors explain the success of R&D evaluation studies in countries with centrally planned economies as well as in those countries with free market and mixed economy systems. R&D evaluation studies have been conducted at different levels: the organisations, the research group and the individual researcher.

Concept of R&D Groups

Contemporary research and development has been taking on the structure of groups or clusters of individuals—moving away from solitary efforts. This trend is stimulated by the increasing complexity of research questions being addressed on the one hand and the phenomenal advances in research technology on the other. Significant research problems are inherently complex and this is reflected in the increase in the number of multi-disciplinary research groups. A rough indicator of these trends is the increase in the proportion of research articles written by three or more authors. Collaborative research is also considered to be more productive in terms of quantity and quality of output. The scientist instead of working as an individual, works as a member of a group.

Hagstrom (1967) observed that R & D groups are formed by the prestigious or otherwise powerful scientists to exploit younger scientists more effectively. Weinberg (1970) and Wilson (1970) observed that research groups are formed because the development towards "big science" with emphasis on expensive heavy equipment, makes them necessary. Stankiewicz (1980) stated that research groups are formed simply because they offer competitive advantage to their members, both senior and junior. The advantage of R&D groups rests on the fact that such groups create the socio-psychological environment which is conducive for individual creativity and productivity. Scientific research is indeed a highly individual activity requiring freedom from rigid formal coordination (Pelz & Andrews, (1976). However, it is also an activity that is greatly stimulated by interactions (communication/collaboration) among the scientists. Such interactions enhance intellectual synergy, i.e. the process by which the scientists reinforce each other's creative potential and work capacity. The specific aspects of this process include the cross-fertilization of ideas, complementarity of skills, coordination of work, communication of tacit knowledge, mutual criticism, error detection and psychological support (Stankiewicz, 1980).

The advantage of R&D groups rests on the fact that such groups create the socio-psychological environment which is conducive for individual creativity and productivity.

R&D groups are staffed primarily by professionals; people who have invested considerable time and energy in preparing for their careers. They are knowledge workers, and bring unique values and expectations to the workplace. Professionals are frequently achievement-oriented individuals who seek motivation from the work itself. A high level of autonomy in managing their own work is important to them, and they are increasingly sensitive to the quality of work environment, climate and culture (Miller, 1986). As scientists and engineers are a precious national resource, it is important that whoever employs them makes the best possible use of their talents. Roman (1968) observed that "The scientist and the engineer usually work in a creative environment. They are essentially solvers of technical problems. ..... their effort is generally part of a larger project and done in concert with many other people..... As a generalization, it can be said that they are intellectually curious and professionally sensitive. The curious, creative, and sensitive worker needs special attention, particularly in R&D, where it is difficult to measure productivity in physical units".

The operating cultures that exist in R&D groups are different from the other groups. In the business, administrative and industrial work groups, the products and the processes are fairly well known in advance. Their tasks are repeatable and people know what each other's specific tasks are. The organization supports this culture with rewards for conformity. However, this type of culture or set of norms for behaviour and interaction cannot be expected in R&D groups. The main reasons are the complexity of research questions being addressed and the speed with which new products are emerging as delay can give a competitor time to introduce a similar product. Thus the hallmarks of culture in R&D groups are: non-repeatability, non-predictability, and non-

boundedness. The professionals who share this type of culture will learn how to function in multi-disciplinary teams that are drawn together for non-repeatable tasks. Within this type of culture, scientists and engineers possess many skills and move freely from task to task rather than stay in one role. The true reward system is for performance and flexibility.

The functioning of a research group implies that it has a set of defined goals, a given structure, certain material and human resources, some form of management, contacts with the outside world and a variety of inter-relationships around the research process. An understanding of these factors and the way they affect the performance of the research group is essential for optimal configuration of human and material resources and management practices.

As R&D is unfettered, and its course is difficult to predict, managing research and development groups is not an easy task. Management principles useful in other types of organisations have had only minimal success when directly transplanted to R&D organisations (Miller, 1986). Nicholson (1963) has aptly said, "The cardinal rule that management should never forget is that many of the usual management techniques simply can't successfully be applied to the research department."

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A number of scientists believe that research—especially basic research—cannot or should not be managed. Dobrov (1969) has lamented the discrepancy between the high stage of scientific and technological development on the one hand and the empirical intuitive organisation through which many spiritual and material resources are used in the development of science and technology on the other. A major reason for this state of affairs is the lack of research effort on the management of research in India, particularly the study of scientific team work (Nagpaul, 1987). Most of the earlier studies were focused on the performance of single scientists (Srichandra, 1970; Laharia, 1978; Ramesh Babu, 1981; Subramanian, 1988). The only exception is the study carried out by Nagpaul and his associates in 1981 (Nagpaul, 1987). The results of these studies cannot be applied to research groups because of the complexity of relationships between the characteristics of the research group and its performance. This implies that the specifics of the research process in groups have to be determined.

Thus, the study of social, psychological, structural, organisational and process features of scientific team work is of great importance, not only from a theoretical perspective but also from the practical imperative of organizing and managing research and development. The study of Veronica Stolte-Heiskanen (1979) indicated that the measure 'quality of research planning' has consistently explained large variations in the R&D effectiveness across the sample of R&D groups belonging to several European countries which participated in the first round of UNESCO ICSOPRU study. While examining the characteristics and quality of research planning along with certain organisational measures at the level of microcosm of the research units in six countries—Argentina, Egypt, India, Republic of Korea, Poland and USSR, Nagpaul and Krishnaiah (1988) reported that intrinsic orientation of the research programme (focus on scientific goals in the selection of research portfolio of the group) and quality of research planning are the most important determinants of scientific effectiveness in all the six countries. Extrinsic orientation (focus on applied goals in the selection of research portfolio of the group) and contacts with the potential users of research results are the most important predictors of user-oriented effectiveness.

In the present study, two important leadership characteristics namely 'leader's R&D experience', 'leader's contacts with hierarchy' have been included. The significance of variation explained by these two variables individually was not tested in any earlier research. Several authors have emphasized that leadership is the premier force in the scheme of organisational events. Since the leader of an R&D group has a dual challenge, having to manage both the technical thrust required and the people who create it, he should have a broad knowledge of organisation and close contacts with higher echelons to vigorously pursue his group's interests. So it is expected that these two variables will significantly contribute to the variance explained in the effectiveness of research groups in achieving their scientific goals and applied goals.

There is no universal configuration of determinants of effectiveness of R&D group and it would essentially depend upon the nature of goals the R&D group is actively engaged in; however there will be some variables that are common to both the sets of predictors that determine the scientific contribution and extra-sceintific

contribution of a R&D group respectively. The current state of research on scientific performance shows an overwhelming imbalance in favour of a micro or individual approach over that of a macro or system approach.

The current state of research on scientific performance shows an overwhelming imbalance in favour of a micro or individual approach over that of a macro or system approach.

The present study investigates various social, organisational and process variables such as research planning, human and material resources, leadership, work climate, communication and their relevance to organizational effectiveness. The study is aimed at identifying general relationships. The particular organisations studied are R&D groups belonging to a major national research organisation, which has a network of laboratories in different fields of agricultural science. The paper relates all the predictor variables together with effectiveness measures thus finding out the important predictor variables that explain variance in the effectiveness of R&D groups. Now it would be pertinent to enquire whether all the organizational measures considered in this study explain significant variance in the effectiveness of R&D groups, irrespective of the goals they pursue. In short, whether the determinants of effectiveness of R&D groups will remain the same or vary with the nature of the group's goals.

Sample

The data for this research come from UNESCO's International Comparative Study on the Organisation and Performance of Research Units (UNESCO ICSO-PRU Report, 1987; UNESCO Report, 1987). In the present study, the terms 'R&D group', 'R&D unit', 'Research group', 'Research unit' have been used interchangeably. The R&D group is operationally defined as a unit that has a total expected life span of at least one year, has at least three core members having worked together for at least half an year, one of them being the supervisor of the group. A core member is an individual scientist or technician, who devotes at least eight hours a week to the work of the group and who has direct or indirect communication with the supervisor of the group at least once in the month. However, in the Indian sample, the core members are whole-time scientists and technicians, and the size of the R&D group ranges from 3 to 75 core members, the median being 11. In the present study, the construction of the sample design has been achieved using a multistage stratified probability sampling procedure. Altogether, 147 R&D groups have been selected from 260 eligible R&D groups of 16 randomly selected institutes of the national R&D organization.

Measures

All the measures used in the present study were derived from items found in the questionnaires administered to the surveyed respondents. A series of items in the questionnaires is presented in the form of a 5-point Likert scale (5 representing high values and 1, low or nil). Most of the measures used are composite. The measures were formed by first computing items means for each respondent group and then averaging these means across groups to yield a unit score for that item. Then the unit scores for a number of items were combined into the overall measures for the particular index to be used. The measures used in the present study have been selected from previously constructed indices. Altogether 25 measures were used in the present study—4 measures of rated effectiveness and 21 measures (ratings or enumerations) representing various structural, organizational dimensions of research groups. Cases with missing data were not used in the construction of measures. The effectiveness measures are:

Scientific effectiveness

Application effectiveness

Recognition

Administrative effectiveness.

Organizational measures

The 21 measures representing various organizational dimensions of research groups are presented below under six broad categories namely (i) Size and age, (ii) Human and material resources, (iii) Research Planning, (iv) Leadership, (v) Work climate and (vi) Communication. All the measures, unless otherwise stated, were constructed on the basis of ratings given by the head and scientists of the research group. All the ratings were given on a 5-point scale (5 = high value, 1 = low value).

Size & age of the group

Group size : The average number of scientists in a research group during the three years prior to the survey. This definition has the advantage of making the variable insensitive to relatively recent fluctuations in the size of a group.

Age of the group : The number of years since a research group was formed obtained by subtracting the year the group was formed from 1985, the year of survey.

In order to meet the requirement of certain statistical techniques used and to reduce skewness, the values taken by the measures of group size were grouped into four categories (<= 4, 5-6, 7-8, >8). The values of group age were grouped into five categories (1-5, 6-10, 11-15, 16-20, >20).

Measures of Research Planning

(i) Quality of research planning

(ii) Focus on scientific goals

(iii) Focus on applied goals

(iv) Involvement in research planning

Measures of Human & Material Resources

(i) Satisfaction with human resources

(ii) Satisfaction with financial resources

(iii) Satisfaction with space, equipment and technical services

(iv) Satisfaction with information services

Measures of Leadership

(i) Leader's R&D experience : The measure is based upon, the number of years of R&D experience the head of the research group had completed. The values taken are grouped into 5 categories (<= 15, 16-20, 21-25, 26-30, >30) to meet the requirement of certain statistical techniques used and to reduce the skewness.

(ii) Leader's professional ability

(iii) Leader's support to his colleagues in their work

(iv) Leader's relationship with hierarchy

The measures of Leader's R&D experience and Leader's relationship with hierarchy were based on the ratings provided by the head of the research group. The other two measures were constructed on the basis of ratings provided by the scientists.

Measures of work climate

(i) Morale

(ii) Job satisfaction

(iii) Career opportunities

(iv) Research autonomy

Measures of communication

(i) Communication within groups

(ii) Communication between groups

(iii) Communication with users

ANALYSIS & RESULTS

The major analyses of the present study were organized as follows. First, to test the stability and strength of relationships between the group size and group age, and the effectiveness measures of R&D groups, the statistical procedure ANOVA (one way analysis of variance) was adopted. Group size and group age were taken as control variables, and effectiveness of R&D groups as different categories of each of these control variables. Pearson correlation analysis was employed to test the bivariate relationship between the effectiveness measures on the one hand and various organizational measures on the other. Finally, step-wise regression analyses were carried out separately for each of the four effectiveness measures to find out the important predictor measures. The total variance explained by the predictor measures in each of these step-wise regression analyses was tested.

Relationship of size & age with effectiveness

The stability and strength of relationships between size and effectiveness of R&D groups, age and effectiveness of R&D groups were tested through one way analysis of variance (ANOVA). The results are presented pictorially in Figures 1 and 2.

The group size is not significantly related to any of the four measures of effectiveness. In fact, the association between group size and recognition is very poor (F ratio is only 0.03) as the average value of recognition in each of the four categories of size almost remained static at 3.6. In the case of scientific effectiveness, its

ASSOCIATION BETWEEN GROUP SIZE AND EFFECTIVENESS

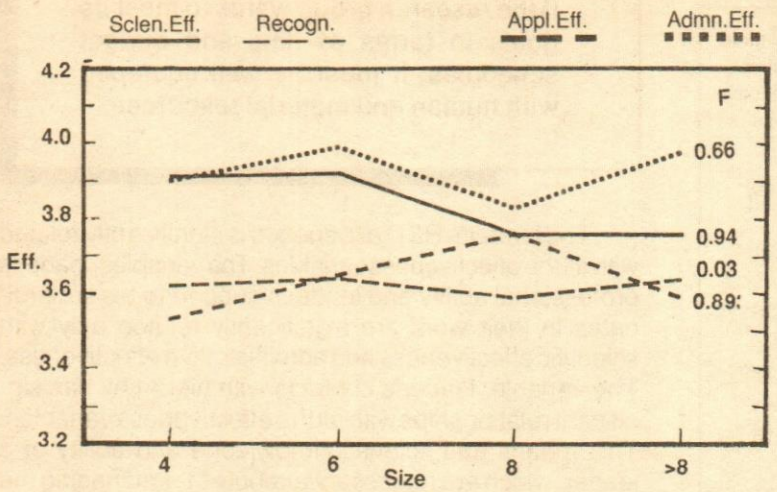

FIG. 1

mean value is the same (3.9) in the first two categories and then slightly decreased as the size crossed the level of 6 scientists. If the group had applied goals, its effectiveness very slowly increased with the size of the group till the group became large with 8 scientists. After that its value decreased from 3.76 to 3.59. Similarly, the variations in administrative effectiveness due to changes in group size are very small.

When group age is related with its effectiveness, the associations between age and scientific effectiveness, age and application effectiveness are not significant. However, the associations between age and recognition, age and administrative effectiveness are significant at 5 per cent level. In both the cases, the average value of effectiveness measures consistently increases till the groups become older with 15 years age. After that the group has become less effective during 15-20 years age. But the effectiveness of a group increases again once it crosses 20 years and reaches the same peak when the group age was in the range of 10- to 15 years. The overall relationships in the data tend to agree with our expectations. The strengths of relationships of group size or age with effectiveness measures are low. These findings suggest that one has to examine the social, psychological and organizational factors for their possible influences on group effectiveness.

Patterns of relationships between organizational variables & effectiveness variables

Table 1 reports the findings on the relationships between all the organizational measures and effectiveness measures. The quality of research planning is very strongly related to all the dimensions of effectiveness (P<.001). This means that if the planning of research programmes of the group is well conceived and if the research programme is coherent, the group achieves its goals effectively — whether in terms of scientific contribution, extra scientific contribution, cost or time. The variables' focus on scientific goals and focus on applied goals are also very significantly related to all the effectiveness dimensions. However, the relationship of focus on scientific goals with scientific effectiveness (r = .52) is relatively stronger to application effectiveness (r = .30). This means that if a research group wants to contribute to scientific knowledge, it has to focus on scientifc goals — the identification of problems which are considered high priority within a scientific discipline, in the planning stage. The involvement of group members in research planning is also strongly related to effectiveness.

Table 1 also reveals that the relationship of human and material resources to effectiveness is generally minimal. The only exception is the relationship with administrative effectiveness. That means, if the re-

ASSOCIATION BETWEEN GROUP AGE AND EFFECTIVENESS

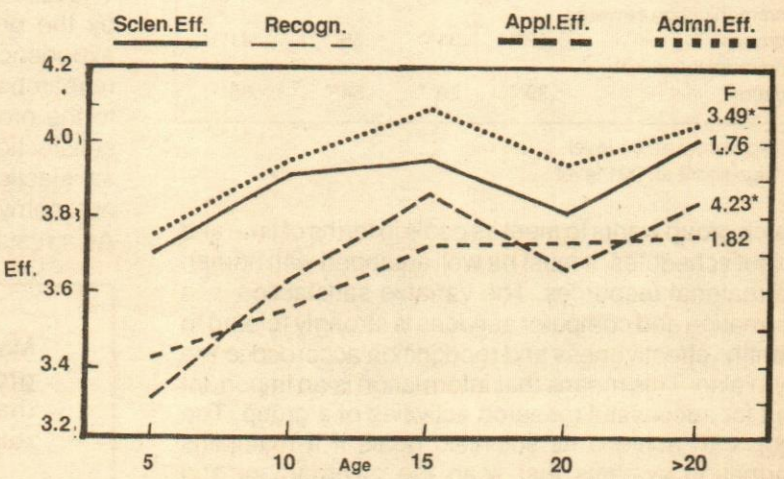

FIG. 2

Table 1 : Organizational Measures Correlated with Effectiveness Measures (Pearson's r)

Organizational Measures	Scientific Effectiveness	Recognition	Application Effectiveness	Administrative Effectiveness
Quality of research planning	.54**	.40**	.39**	.49**
Focus on scientific goals	.52**	.41**	.30**	.31**
Focus on applied goals	.48**	.39**	.46**	.38**
Involvement in research planning	.42**	.28**	.24*	.37**
Satisfy. with human resources	.16	.04	.06	.18
Satisfy. with financial resources	-.09	-.19	.06	.21*
Satisfy. with space, equipment and technical service	.20	.07	.13	.24*
Satisfy. with Inf & computer services	.35**	.29**	.11	.28**
Leader's R&D experience	.32**	.38**	.32**	.21*
Leader's professional ability	.27*	.11	.02	.21*
Leader's support	.26*	.16	.09	.27*
Leader's contacts with hierarchy	.27*	.21*	.28**	.26*
Morale	.47**	.22*	.27*	.40**
Job satisfaction	.44**	.33**	.39**	.34**
Career opportunities	.20	.03	.15	.31**
Research Autonomy	.41**	.32**	.28**	.32**
Communication within the group	.31**	.12	.14	.20
Communication between groups	.42**	.31**	.36**	.41**
Communication with users	.39**	.29**	.54**	.36**

* Significant at. 01 level
** Significant at. 001 level

search group wants to meet its goals in terms of time and budget schedules, it must be well equipped with human and material resources. The variable satisfaction with information and computer services is strongly related to scientific effectiveness and recognition accorded to the group also. This means that information is an important input for successful research activities of a group. The group can achieve its scientific goals if it maintains information systems that scan the environment and support the preparation of forecast for the future.

If the research group wants to meet its goals in terms of time and budget schedules, it must be well equipped with human and material resources.

The leader's R&D experience is significantly related with all the effectiveness variables. The variables, leader's professional ability and leader's support to his subordinates in their work are significantly related only with scientific effectiveness and administrative effectiveness. The variable, leader's contacts with hierarchy has significant relationships with all the effectiveness variables. This means that scientific knowledge and ability of a leader, which are necessary attributes for managing the technical thrust of the research group he leads, are not sufficient for improving the effectiveness of the group if it has extra scientific goals. It is a leadership that can build support networks not only with subordinates but also with higher echelons of the organization which makes the research group effective. The results indicate that if the leader has a combination of long experience, good knowledge in the research fields in which the group is actively working, supportive nature and also maintains close contacts with superiors, he can provide effective leadership to the group for achieving its technical as well as administrative goals. The results taken together indicate that leadership of a research group is strongly related to its effectiveness.

The findings or relationships between work climate measures and effectiveness measures indicate that except for career opportunities, all other climate variables are strongly related to all effectiveness measures. The results indicate that maximization of scientific effort by the group members takes place in a group that experiences better working environment. If the group's research work is conceptually exciting and challenging to the group members, it generates commitment and satisfaction in the minds of scientists. The better job satisfaction, high cooperation, innovative spirit and autonomy in the work make the group more dedicated. As a result, it becomes more effective.

Maximization of scientific effort by the group members takes place in a group that experiences better working environment.

Table 2 : Stepwise Regression Analysis of Variables Best Predicting Effectiveness

Scientific Effectiveness	Beta	cum R^2	Recognition	Beta	cum R^2	Application Effectiveness	Beta	cum R^2	Administrative Effectiveness	Beta	cum R^2
Quality of res. planning	.28	.29	Focus on scientific goals	.23	.16	Communication with users	.37	.28	Quality of res. planning	.39	.23
Communication between groups	.21	.34	Leader's experience	.33	.26	Leader's experience	.28	.34	Communication between groups	.28	.29
Financial resources	-.23	.39	Leader's contract with hierarchy	.27	.30	Focus on applied goals	.22	.39			
Focus on scientific goals	.25	.43	Financial resources	-.26	.35	Leader's contact with hierarchy	.18	.41			
Leader's experience	.23	.46	Quality of research planning	.21	.37						
Leader's contact with hierarchy	.19	.48									
F ratio	14.98**			11.58**			15.07**			19.25**	

Note : Predictors, not shown in the table, added less than 0.02 to the variance explained in Effectiveness Measures.
** Significant at. 001 level.

While all the relationships of communication variables are positive, the relationships of communication between groups as well as communication with users are very strong. The strongest relationship is between application effectiveness and communication with users (r = .54). This means that the group requires extensive inputs from the potential users of its research results, if it has to contribute effectively to its applied goals. The results support the Schomookler popular notion that inventions and market needs are two blades to the scissors of innovation.

Determinants of effectiveness

To examine whether the set of important factors that determine a research group's effectiveness vary with its nature of goals, separate step-wise regression analyses were carried out for the four dependent variables—scientific effectiveness, recognition, application effectiveness, and administrative effectiveness respectively. The results are presented in table 2.

The factors that determine scientific effectiveness of a research group are quality of research planning, communication between groups, financial\ resources (with negative Beta value), focus on scientific goals in the selection of research portfolio of the group, leader's contacts with hierarchy, in that order. These predictors together explain 48 per cent of the total variance in the criterion variables, which is highly significant (F = 14.98; level of significance = .001). When recognition is the criterion variable, all the determinants of scientific effectiveness, except communication between groups, entered the step-wise regression model. The model explains 37 per cent of the variance in the criterion variable, recognition, which again is highly significant.

The next model is of the application effectiveness. As expected, communication with potential users of research results is the best predictor of application effectiveness. It has entered the regression model in the first step and has explained 28 per cent variance in the criterion variable which is significant at .01 per cent level. The other predictors entered in the model are leader's experience, focus on applied goals in the selection of research portfolio of the group and leader's contacts with hierarchy. These four factors together explain 41 per cent variance in the criterion variable (F = 15.07; level of significance = .001).

The set of factors that determine the administrative effectiveness of a research group include only two predictors, namely, quality of research planning and communication between groups. They explain 29 per cent variance in the criterion variable which is significant at .01 level.

The foregoing results support our hypothesis that the set of predictor variables of effectiveness vary in relation to the nature of goals the R&D groups pursue. If the goal is to contribute to the development of scientific knowledge and getting recognition from the scientific community, then the group's research programme should be well conceived, objectives of the group should be closely related and the group should plan the research with a scientific orientation. On the other hand, if the goal of the research group is to contribute to the development of processes or products for commercial production or to the solution of societal problems, then the group must

maintain continuous contacts with potential users of anticipated research results and the planning process should emphasize projects. The leader of a group plays a major role for achieving the group goals irrespective of their nature. His long experience benefits the members in terms of guidance, coaching etc., his close contacts with higher echelons of the research institute benefits the group getting resources for the group as well as recognition for its effort.

Discussion

The effectiveness of R&D activities cannot be evaluated by a single universal criterion. The study identified several goals pursued by R&D groups and constructed four composite measures incorporating both the theoretical and scientific dimensions (intra-scientific) and the dimensions dealing with application and utilization of scientific knowledge (extra-scientific). The results do not give any evidence of an optimum or critical size effect on group's performance. These results imply that the intellectual synergy of an R&D group does not depend on numbers alone but also on the quality of research planning, cohesiveness of the group, leadership etc. With larger numbers, the group may tend to segment. The decreasing cohesion and increasing competitiveness may neutralize the advantages of large numbers in the group.

The set of determinants of effectiveness of R&D groups would essentially depend upon the nature of goals the groups actively pursue. If the criterion for effectiveness is contribution to the scientific knowledge and getting recognition from the scientific community, the determinants are quality of research portfolio, external communication with R&D professionals, leader's experience and his contacts with superiors in the Institute. On the other hand, if the criterion for effectiveness is contribution to solution of identified economic and societal problems, the communication with potential users of research results is the best predictor. The implication is that it cannot lay down a universal prescription of factors for improving the effectiveness of R&D groups. It must examine the social-psychological and organizational factors and research processes in an R&D group in relation to the goals and objectives set for that research group.

The results of the study have clearly demonstrated that the quality of research planning is important, not only for effective performance, but also for better morale and motivation of scientists. These results imply that management of research institutions should pay greater attention to the selection of research portfolio, particularly its thematic coherence and congruence of different scientific and technological objectives. Thematic coherence of the research programme is essential to ensure that physical, intellectual and motivational resources are not thinly distributed among fragmented and disjoined research problems. Research plans must be carefully established and significant research problems compatible with these plans must be selected.

Significant research problems are conceptually exciting and command greater personal involvement, energy and commitment of researchers than non-significant research problems that may be perceived as dull and routine. It is, therefore, essential that management should provide incentives for improving the quality of research proposals and their appraisal.

The study brings out that the objectives of the R&D group should determine the character of research planning. If the objective is to make contributions to the advancement of science and technology, the planning process should lay emphasis on those projects which are scientifically significant and are at the frontiers of knowledge. On the other hand, if the objective is to meet the societal needs, the planning process should lay emphasis on the criteria of application potential and social utility and should involve communication with potential users of research results.

Effective research planning requires extensive, carefully tailored inputs from a variety of sources, both internal to the group and external. The need for group members to feel that they nave participated in the planning process is as important as orchestrating diverse inputs. In fact, the results of the study indicate that members of effective R&D groups perceive that they have played a key role in choosing what they have worked on. These results imply that management must foster participation as means of satisfying the scientist's non-material needs and accomplishing the organization's achievement goals. Participation promotes better sharing of responsibility and develops a feeling of ownership over the functions being performed. It also promotes intrinsic interest of the scientists / engineers in the job, and this can result in remarkable improvements in productivity and morale.

For science policy makers and managers of R&D faced with the problem of allocation of scarce resources among competing alternatives, an important aspect is the role material resources play in the effectiveness of research groups. Surprisingly the results of the present study showed a consistent absence of notable relation-

ships between indicators of economic or physical resources and effectiveness. Once the resource base is sufficient to keep a research group viable, there is no necessary linkage between material endowment and research performance. This view is also supported by Stolte-Heiskanen (1979). This may be explained by the nature of R&D itself, whose effectiveness is not a continuous and linear function of capital input. Indeed, the action of R&D on the progress of science and technology has a more random and catalytic nature. Sudden breakthroughs occur at unforeseen intervals, and these may in some ways be compared to genetic mutations. The output of such process—when they occur—is a hundred or thousand fold out of proportion to the input. The findings thus imply that planning and allocation of material support to research activities must go beyond a simple cost-benefit approach to the determination of the optimum organizational, managerial, and psychological conditions for successful R&D.

The study examined the role of leadership for effective performance of R&D groups. As could be expected, the results show that leader's R&D experience and his contacts with organizational hierarchy are two most important predictors of effectiveness of R&D groups. These findings should alert R&D management to the damages of promotion of inexperienced researchers to the position of research group leaders. Young, inexperienced leaders still concentrating on the establishment of their personal scientific careers and reputation, mainly try to get ahead by focusing on task-oriented activities promoting their own work. This is partly explainable by the way the advancement system in science operates, where individual output of scientists is particularly important in the early part of one's career. It is only after a position is attained that scientists extend their activities in other directions, including collectivity orientation.

The issue before R&D management is how to select leaders who have the right combination of required skills or how to improve the level of leadership of research groups. The results of the study also indicate that the leader's scientific knowledge and professional competence is less important than his managerial capability to motivate the researchers and integrate them to function as a team. So the management of research organizations should lay emphasis on the criteria of professional competence and managerial qualities while selecting leaders of research groups. It would also be essential to improve the level of expertise of the leaders through a package of incentives like sabbatical leave to enable them to work at centres of excellence within or outside the country and by inviting leading scientists from such centres to work in the respective institutions.

Research groups are entities operating in an institutional setting with various degrees of autonomy from their institutional and external environment (e.g. sponsors, science policy making bodies). The role of autonomy in effectiveness closely depends on the goals of the research activity. The greater the amount of influence exercised by sources within the group, the higher the group is likely to perform on aspects of performance often associated with scientific orientations. If the goal is to contribute towards the development of products or the solution of societal problems, then the influence exercised by the group has relatively weak relationship with effectiveness. These findings once again point to the importance of a flexible R&D policy strategy, based on the expected results from the research activity. With respect to the achievement of "societal" or "economic" goals, the active involvement in the goal setting of sources external to the research group seem necessary. External influences, on the other hand, are unable to promote the effective achievement of traditionally internal scientific goals. When expectations focus on such research goals, scientists are apparently best left alone. In any case, working autonomy is always necessary for the R&D groups irrespective of the goals of research.

The performance of R&D groups depends critically on free flow of information from outside the groups and effective exchange of technical and administrative information within the groups. External communication with R&D professionals and communication with potential users of research play an important role in the performance of a research group in terms of the internal and external dimensions of research respectively. It is, therefore, essential that deliberate mechanisms are created and financial resources are provided to encourage the scientists to visit other research institutions and industrial enterprises and participate in seminars and conferences. However, the barriers to communication are not solely due to lack of financial resources. They are also due to organizational and socio-psychological factors. In the traditional budgeting system, these kinds of investments are considered as extra expenditure; for there are ceilings on budget for travel, little avenues for mobility and virtually no provisions for sabbatical leave in scientific institutions in the country.

Conclusion

Scientific and technological research has become a complex system incorporating psychodynamic, inter-

personal, institutional and economic factors. By manipulating these factors through appropriate policies and management practices, it is possible to nurture quality, productivity and effectiveness of research effort. Since different R&D groups face different problems in different environments, one needs a flexible management strategy. The results of the present study suggest that it would be unwise to impose mechanically a common pattern of R&D management.

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***Rules for Quick Thinking under Pressure*:**

1. Split the problem into parts.
2. Learn to relax and concentrate by—
   - Using some physical device to divert your nervous energy.
   - Visualizing the problem in tangible terms.
   - Really worrying about the problem.
   - Priding yourself on quick-thinking ability.
   - Preparing a stock of delaying sentences.
3. Ask questions in return.
4. Divide the predictable from the unpredictable.
5. Stress the facts that are known.

Source : Charles A Cerami: How to Solve Management Problems, Englewood, Prentice Hall.

Corporate Vision & Quality Policy : Creating an Organisation Culture

Total Quality Management is concerned with the integration of all the efforts of an organisation towards quality improvement, quality development and quality maintenance to meet full customer satisfaction. Productivity can be enhanced considerably by improving the quality of products, services and all the activities. TQM develops a culture where each employee can directly participate in areas and decisions concerning his work. It therefore builds positive attitudes in employees towards quality, organisation and respect for each other leading to a work place meaningful to be in. Total quality is an approach to improve the effectiveness and flexibility of organisation as a whole.

Culture & Values

One of the most important contributions of TQM is to create an organisation culture and value system which is not only desirable but also basic to the organisation and its objectives. It is achieved through a planned focus on quality and customer. Culture is defined as "that body of customary beliefs; social norms and material traits that constitute a distinct, but a complex pattern of traditions of a national, religious or social group—it is a complex whole that includes knowledge, beliefs, morals, laws, customs, opinions, superstitions, religion and arts", (Webster Dictionary). It is difficult to identify the factors and elements of culture as it merges into the rules, regulations and traditions of an organisation. It becomes a part of work habits and may be invisible to the present management.

Values may be defined as general behavioural norms learned in early childhood on how to evaluate the meaning of one's existence and that of others. Each human group develops and supports in its members a set of values consistent with its specific economic and social necessities for survival and growth. For the feeling of security that values provide, they are seldom changed. This happens only when an alternative that offers a more attractive set of values is available and can take the place of the other order in all respects. TQM changes the culture and values which are both visible and invisible by a continuous improvement process. That is why TQM is regarded as a long-term intervention. It catalyses rethinking on current practices, ethos, culture and values (Kuppachi, 1992).

Corporate Vision

Managerial values embedded in a cultural ethos do affect the organistion leadership, goals and strategies. While trying to shape a company into a total quality company, the traditional values unique to that company should not be discarded as medieval, but be intelligently harnessed and integrated to build a congenial work environment to motivate people for higher quality and productivity.

Today, quality has developed into the most important competitive weapon. Quality is no more a control function, it is a company's strategy.

Today, quality has developed into the most important competitive weapon. Quality is no more a control function, it is a company's strategy. It has to form a part of the corporate strategy of the organisation. Quality is the result of the corporate vision of a company. Policies and objectives are required to provide both a context and a focus for the quality improvement actions taken by all employees (Jones, 1992).

Mission Statement

The Mission Statement of companies has assumed undeniable importance in the present work environment. It gets converted into specific objectives and goals and finally into activities. Quality Policy becomes an effective instrument in achieving the overall management intentions and provides a direction to the company. The following is the Corporate Mission of Indian Oil Corporation which incorporates all the ingredients of TQM:

* To achieve international standards of excellence in petroleum refining, marketing and transport *with concern for customer satisfaction.*
* To create a modern technology base for self-reliance, growth and development of the business.
* To contribute to the national economy by providing adequate return on investment and by setting high standards of *leadership in productivity and total quality.*
* To foster *a culture of participation and innovation* for employee growth and contribution.
* To help enrich *quality of life* of the community and preserve ecological balance and national heritage.

Quality Policy

Major changes in any organisation do not just happen by chance but are the result of planned management efforts. These changes are initiated by planning a particular shift in the management approach within the given business environment.

A sound quality policy is a fundamental requirement, if an organisation is to start implementing TQM (Singh, 1991). The organisation should develop and state its policy on quality to make it known to all employees. The first sub-clause of the first clause of the International Quality System Standard, 4.1 on Management Responsibility states - "The supplier's management shall define and document its policy and objectives for, and commitment, to quality. The supplier shall ensure that this policy is understood, implemented and maintained at all levels in the organisation" (ISO 1991).

In TQM and also in ISO 9000 quality systems, an organisation has to work with policy guidelines on quality. This requirement of the standard can be broken down into policy, objectives, commitment and communication. The policy statement should clearly commit the company to the attainment of the specified requirements for product quality and to assuring conformance of the product by establishing and implementing a quality system. The quality policy should also be consistent with other company policies. It should reflect the management's intention to pursue quality as a business principle. Top management, should not only endorse the quality policy, but should also be actively involved in formulating it. Let us consider, for example, the quality philosophy and quality policy of Modi Alkalis and Chemicals Limited.

Quality Philosophy

Quality in MACL means satisfied customers, both external and internal.

It is the concern of each employee to build and sustain this organisation by creating a reputation for achieving leadership in quality in India and abroad.

Our philosophy is to reflect our integrity and meticulousness in all our activities in order to establish credibility with customers and vendors and to build a culture imbued with trust, values and dedication to work.

Quality Policy

— Quality is job No.1

— To do everything right the first time, everytime

— To maintain a pollution-free and safe environment

— To involve all employees, vendors and customers to continuously develop, adopt and improve technology for enhancing productivity, effectiveness and quality

— Commitment to manufacture products of highest quality and to provide service for complete customer care

Yogendra K. Modi
Vice Chairman &
Managing Director

Quality policy is built on:

* Customer satisfaction (internal and external)
* Image as Quality Company
* Quality reflection in all activities
* Establishing credibility with vendors
* Team spirit
* Technology upgradation
* Employee involvement

These implications of the policy have to be converted into objectives which address the key features and characteristics of the product or service. The objective must be measurable to enable implementation of the quality policy.

Documentation of Quality Policy

One of the requirements of ISO 9000 standards is documenting a quality policy. So, is the requirement of TQM. When defining and documenting the quality policy, an organisation should consider the following:

* The quality policy should be derived out of the organisation's corporate mission, philosophies and its other policies, the products or services provided and the organisation's people.
* The objectives should be ambitious and achievable.

The management should demonstrate commitment actively on a continuing basis, by:

* Ensuring that the organisation's people understand and implement the quality policy.
* Initiating, organising and following up the implementation of the quality policy, including the quality system.
* Not allowing deviations from the quality policy or wastage of resources in any part or aspect of the organisation.
* Reviewing periodically the appropriateness of the policy and its implementation.

Communication of Quality Policy

The methodology adopted to ensure understanding and communication of quality policy depends upon the size and complexity of the organisation. One of the methods is to print the policy in the form of a card and distribute to all the employees. This is followed up by explanation by the managers and supervisors down the line through short seminars. The policy may be published in company newsletters and other documents. It may also be kept in prominent places in the company. Whatever method is followed, it should be recorded to demonstrate that all the levels in the organisation understand and share the management's concern on quality. In the event of a dispute between the quality function and production, the management must support the former; otherwise deadlines not conformance to specification will run the system, and the quality management system will become a charade. If the system is properly installed and managed, better morals should be an automatic end result (Rothery, 1992).

Commitment & Leadership

Introduction of TQM is concerned with major changes in culture and management style. TQM is far more complex than other change strategies and interventions and therefore requires a great deal of commitment and planning. Companies committed to driving TQM through their organisation admit to having difficulties in flexibility training and briefing groups. (Atkinson, 1991). In small organisations, the formulation of quality policy may be done by the chief executive personally, in consultation with his senior managers. In large organisations, the policy is normally developed by the quality assurance manager and authorised by the board of directors or chief executive. Quite often it may be done by a Steering Committee constituted for implementing TQM.

Conclusion

More than eighty per cent initiatives on TQM will fail if they do not have the backing of the top management team. TQM cannot change an organisation overnight and it cannot address the neglect of years. The quality policy in TQM provides vision, inspiration and direction to the management team. In turn, the managers provide a mission and vision for others to follow. They become the real change masters. The leadership issue is critical for a successful TQM drive.

TQM cannot change an organisation overnight and it cannot address the neglect of years.

If a company invests in developing a coherent managerial style, it can create a meaningful transition to TQM and to an organisational culture where people *want* to work. Corporate philosophy and quality policy lead the way to creating a culture and driving it through the entire business. Nobody down the line will change unless the organisation adopts a corporate change strategy to become a total quality company.

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How to foster cluster

- Identify existing or potential clusters of successful industries within the nation. Potential clusters may be those that incorporate a specific technology in which the nation is a leader, or which are particularly well suited to the skills of the local workforce, or which satisfy a demand that is particularly sophisticated in the nation.
- Invest in developing the major technologies and capabilities that cut across the industries in the cluster. Such investments will have the greatest leverage in deepening and broadening the cluster. They should include development of indigenous technology as well as acquiring best practice technology from abroad.
- Identify the "holes" in the cluster, the supplier and related industries that are not well developed in the nation. Such industries may provide opportunities for the nation's firms. In addition, gaps in a cluster may weaken the entire structure. Attempts should be made to fill such gaps if feasible, perhaps using the targeted attraction of foreign investment if necessary.
- Ensure that rivalry permeates the cluster. Cooperation within a cluster should not reduce rivalry to the point where the cluster becomes vulnerable to firms in more dynamic environments.

Source : WORLD LINK, July-Aug. 1992

Urban Poverty: Some Issues

Studies concerning poverty continue to interest scholars of various social science disciplines. Consequently, a number of studies attempted several alternative methods of estimating the levels of rural poverty in India (Hanumappa, 1979). While landholding data was used by some scholars to estimate rural poverty, data on assets was used by a few others. A third category of studies used income as a measure to estimate poverty in India (Bhatty, 1974). All these exercises aimed at the single objective of assessing the incidence of poverty in the country as a whole or its inter-state differences. But lately, the differences in the nature, causes and extent of poverty between rural and urban areas are being studied as distinct entities. Though issues concerning urban poverty in India are receiving considerable attention from researchers and administrators at national as well as regional levels, very little has been done to eradicate it.

Identification of the Urban Poor

During fifties and sixties, the Research Programme Committee (RPC) of the Planning Commission sponsored a series of socio-economic studies of a number of cities to trace trends in urban life-styles. This helped researchers to view urban household data at a much more disaggregated level. These city surveys provided a new perspective for understanding poverty issues within the urban framework. Not satisfied with this type of socio-economic surveys, attempts were made to understand city life by adding spatial aspects (Prakasa Rao and Tewari, 1979). These efforts were aimed at a search for some kind of a pattern of poverty in urban areas. All these exercises highlighted the fact that generally, the socio-economic structure of urban areas offers more challenges for the survival of the poor than their counterparts in the rural areas (H.G. Hanumappa 1978 and 1991). In addition to several anti-poverty programmes, the rural poor also have the advantage of village community life and support during periods of acute hardships. This facility is not available to the urban poor even though their regional and linguistic affinities cluster them in the form of slums.[1]

The socio-economic structure of urban areas offers more challenges for the survival of the poor than their counterparts in the rural areas.

Absence of Large-Scale Programmes

Deprivations due to maldistributioin of resources are responsible for poverty in rural as well as urban areas. But in rural areas, the levels of these deprivations vary across different categories of poorer sections (who have been identified as small or marginal farmers, landless agricultural labourers or traditional artisans and the like) and the government is implementing a massive programme under the banner of Integrated Rural Development Programme (IRDP) to alleviate rural poverty. In the case of urban areas, neither clear-cut identification of different categories of poor has been attempted nor are there any large-scale anti-urban poverty programmes being designed to treat this malaise. One of the major constraints for treating such a malaise has been the enormous growth of urban population and the consequent pressure on urban services. But a large proportion of the growing urban population continues to be the migrant rural poor. Hence, it is necessary to realise that 'urban poverty is an overflow of rural poverty' (Dandekar and Rath, 1971) and its alleviation needs to be integrated into the overall anti-poverty programmes of the country. A major reason for the continuous migration of the

1. Government of India has launched a Self-Employment Programme for the Urban Poor (SEPUP) as one of the steps for reducing the incidence of urban poverty in the country.

rural poor is the weak economic base of the rural areas which remained so due to the over-emphasis given to growth inducing factors rather than pursuing a policy of equity through redistribution (Paul Streeten, 1978). The rapid growth of economic activities in urban areas in recent decades attracted millions of rural poor to cities in search of livelihood (Alfred De Souza, 1978). Thus the urban poor emerged as a distinct class in India, but they continue to have socio-cultural links with their rural counterparts (Hanumappa, 1991). This aspect needs to be kept in mind while seeking answers for several issues connected with the life-styles pursued by these people in the urban environment. 'Who' are the poor people? 'Why' do they migrate to urban areas? 'Where' do they come from? To find answers to these basic questions, one has to attempt a thorough examination of social, economic, demographic and various other characteristics of the households and juxtapose them with one another.

Survival of the Urban Poor

When the rural poor migrate to urban areas, they face a number of problems. They undergo a process of change in their socio-cultural outlook as they arrive and settle down. Most of the migrant poor live in slum areas and their problems of adjustment begin with the limited living space and the activities which they pursue for their survival. They encounter a more competitive environment. In spite of these survival issues which are mainly due to economic deprivations, the urban poor as a class cluster residentially on linguistic, regional, religious and caste basis. This type of clustering of poor people based on certain non-economic factors depends on the availability of sufficient space for their spread as well as for the emergence of new slums (Prakasa Rao and Tewari, 1979).

As the city grows in its physical size, the migrants are attracted depending on its productive structure (industrial, commercial or service domination). Most of the time the migrants' over-estimation of the advantages offered by cities result in large scale influx and a major part of this influx comes from within the immediate influence zone (geographical periphery consisting of rural hinterland areas and small towns) of the city. This is evident from one of the studies conducted in Bangalore (H.G. Hanumappa, 1991). Table 1 clearly indicates this trend.

Table 1 : Percentage distribution of poor migrant heads of households in Bangalore

State from which migrated	Rural	Urban	Total
Karnataka (within)	71.07	47.06	61.17
Tamil Nadu	17.36	29.41	22.33
Andhra Pradesh	6.61	16.47	10.68
Kerala	4.96	3.53	4.37
Others (Rest of India)	—	3.53	1.45
	100.00 (121)	100.00 (85)	100.00 (206)
Row Percentage	58.74	41.26	100.00

Source: H.G. Hanumappa, 1991

Note : Figures in brackets are actuals.

Most of the immigrants to Bangalore hailed from different parts of Karnataka (61.17 per cent) followed by Tamil Nadu (22.33 per cent), Andhra Pradesh (10.68 per cent), Kerala (4.37 per cent) and the rest of India (3.53 per cent). But the rural-urban origin of these migrants showed that a very high proportion among rural migrants (71.07 per cent) came from different rural areas of Karnataka, whereas 47 per cent of urban migrants originated from differnt urban areas of Karnataka. In the case of Tamil Nadu and Andhra Pradesh, Banglore received more percentage of poor from their urban areas than the rural counterparts. There was a marginal difference in this trend in respect of Kerala migrants. But all the migrants from the rest of India had urban origin only. Table 1 indicates that from among the poor who were migrating into urban areas, a greater proportion belonged to the category of rural to urban migrants as compared to the category of rural to urban migrants as compared to urban to urban migrants. One comes across similar results from several other urban studies (Prasantha Majumdar and Ila Majumdar, 1978).

Role of Government

The uncontrolled growth of new slums in urban areas is also due to the increasing opportunities available for pursuing several urban informal activities by the poor. Street vendors, waste paper pickers, mobile cobblers, and other service workers are some of the urban informal activities undertaken by the poor (Linda, A. Paul, 1985). The government and some voluntary agencies have tried to organise these groups in order to raise them above the poverty line (Howard Spodek, 1983). But the urban informal activities are so many in

number and so diverse in nature, that the government finds it difficult to organise them under specific categories. This is not to discount the experiments conducted by such agencies as Leather Industries Development Corporation of Karnataka (LIDKAR) which assigns small scale footwear manufacturing contracts to poor roadside cobblers. There is need to extend such experiments, to roadside fruit and vegetable vendors, waste paper pickers etc. Apart from organising and experimenting, the government needs to bring out legislations with regard to minimum wages to be paid to the workers hired for informal sector activities like the maidservants, labourers working for waste paper picking etc. Even though the magnitude of urban poor in percentage terms is less as compared to the rural poor, in terms of their absolute numbers (about 80 millions), the government faces a daunting task.

The government needs to bring out legislations with regard to minimum wages for informal sector activities.

Policy Measures & Conclusions

The migrant poor remain handicapped by lack of skills suitable to urban needs and it is essential to organise and train them under anti-urban poverty programmes, which can promote self-employment projects. All the poor living in urban areas should not be treated as one homogenous group for designing and implementing programmes to improve their living standards. Broadly, urban poor can be classified as destitutes and non-destitutes (Hanumappa, 1991). Households which can be treated as destitutes are those reporting a very low income and as a result live under unbelievably desperate conditions. For such cases, the policy should be one of total protection under special social security schemes. At present, the government does not seem to have any definite policy on urban poor like squatters and the slum dwellers. Howard Spodek (1983) while examining this issue in detail said that, 'Today too, under an independent government, Central, State and individual city policies continue to vary widely to lack continuity of purpose, and to be implemented only erratically....' Therefore, there is an immediate need to evolve a set of consistent policies and programmes to eradicate urban poverty.

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Feature

Managing Public Sector Organisations : Reflections from a Developing Context

Palmer B. Johnnie

This paper makes an attempt at historiography, by assessing some management styles. We examine some of the major contributions of early scholars and how they have helped to influence management thinking in modern workplaces. Another area of concern of this paper is a critical examination of two areas of modern management methods or techniques (Management by Objectives, MBO and Organisation Development, OD) and their contributions towards the growth of work organisation in the public sector, both in developing and developed countries. In the final analysis, this paper examines the role and influence of MBO and OD on current management thinking in the public sector and the extent to which cultural and economic factors had affected the growth of these techniques in a developing context.

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Management as a growing field or discipline is fast capturing the attention of administrators, both in the developed and developing countries of the world. This phenomenon cannot be possibly averted because work organisation in all modern workplaces has to be done in a scientific and well planned manner in order to achieve organisational goals. The achievement of the goals of any organisation is a function of the methods and techniques adopted by the managers of these organisations. However, there may be other factors at play that could militate in favour or against the methods and techniques designed by these organisations to achieve efficiency and effectiveness.

The achievement of the goals of any organisation is a function of the methods and techniques adopted by the managers of these organisations.

Evolution of Management Thought

One of the cardinal objectives of all organisations is the adoption of appropriate work organisation methods and techniques to achieve organisational efficiency. The determination or measurement of efficiency and effectiveness is a function of the aims and objectives of the organisation. Some organisations, particularly, those in the private sector have almost always used profits as the most veritable index for determining their level of efficiency. Public sector organisations have attempted to define efficiency based on their ability to satisfy the needs of the public in terms of the quality of services they render. No matter the aims and objectives of any organisation, it attempts to adopt certain important

management principles to achieve the goals. But because of the changing times and environments in which organisations operate, they travel through periods characterised by change. These periods could be represented by different work methods, techniques and managerial principles and practices.

The most monumental efforts in the development of work methods, techniques and managerial principles in the developed countries are the early works of Taylor (1911), in which he advanced the notion of "Scientific Management". Taylor's scientific management principles placed considerable emphasis on specialisation and routinisation of work processes in order to increase productivity and efficiency in organisations. Porter et al (1975) have argued that Taylor's effort was successful as a result of the emphasis he placed on specialisation and routinisation which led to the emergence of a number of critical managerial functions. These include, task analysis, selection, training, rewards and goal-setting. Taylor had always insisted that well designed jobs will ultimately lead to higher productivity and efficiency. However, Arnold and Feldman (1976) have argued that "although scientific management presents many potential advantages to an organisation, it also tends to create high levels of monotony, boredom, and dissatisfaction among organisation members." Whatever may be the case against or in favour of Taylor's thesis, one of his associates, Fayol (1929) also introduced the concept of a hierarchical structure (scalar chain) in which each stage in the chain was given levels of authority and responsibility. Fayol introduced the scalar principle as a method of work organisation.

Although scientific management presents many potential advantages to an organisation, it also tends to create high levels of monotony, boredom, and dissatisfaction among organisation members.

Other contributors to the process of developing appropriate methods and techniques in work organisation in their time were Frank and Lillian Gilbreth (1912). Their focus at that time was the systematic development of work measurement techniques through Motion Study. Mary Parker Follett (1918) who spent a larger part of her career in public service set out to improve conditions in organisations through participation of workers in organisational activities and the solving of human problems through effective conflict management techniques. Others whose contributions have been acknowledged as pioneering efforts were Elton Mayo (1953), who studied groups, both formal and informal. And Brown (1949) who put forward the thesis that there are three social systems within the organisation — executive, representative and legislative. Jacques (1956) also used "action research" techniques to study the psychological forces affecting groups. He discovered that an individual needs to understand (and know at his colleagues understand) his role and status in a group. Jacques also found, from analysis of statistics in the United Kingdom and Holland, the job evaluation theory of 'time span of discretion'. This theory relates a manager's salary to the time period that elapses between the taking of a decision and the time when the effects of that decision become known.

In the later part of the twentieth century, other work organisation methods such as Job Enlargement was introduced. Advocates of Job Enlargement System argue that while Taylor (1911) attempted to fractionalise jobs by breaking them into smaller units to create room for specialisation and routinisation, they believe in "putting back together" bits of the jobs that have been fractionalised. Beyond Job Enlargement System, the "Two-Factor" theory of Motivation and Job Satisfaction was developed by Herzberg and his associates (Herzberg, 1966, 1968, 1974, 1976; Herzberg et al : 1957; 1959). This led to the emergence of Job Enrichment techniques to Job Design. Other contemporary advancements in the organisation of work are the seminal works of Turner and Lawrence (1965), Hackman and Lawler (1971), Hackman and Oldham (1976, 1980). These studies concentrated on what is generally known as Job Characteristics approach to Job Design. The major focus of this approach is the determination of the specific aspects or characteristics of jobs that influence people's response or reaction to their work.

Other perspectives of work organisational methods developed by scholars and practitioners include, "Bureaucratic Organisation" (Weber, 1947), "Administrative Management" (Fayol, 1929; Mooney and Reiley, 1931; Urwick 1943), "Humanistic Organisation Theory" (Reothlisberger and Dickson, 1939; Mcgregor 1960; Argyris, 1957, 1964 and Likert, 1961, 1967). These scholars concentrated on human relations and the interaction between organisation structure and human characteristics. They made attempts to remove the incompatibility between human nature and the bureaucratic structures found in most organisations designed along classical doctrines and traditions.

New Methods to Enhance Public Sector Efficiency

The dynamic nature of our environment has made it almost impossible for us to adopt most of the management techniques that were popular a few decades ago. Some of these methods now appear to be limited only to the time and place of their origin, in terms of their efficacy. Modern management experts in collaboration with researchers have continually searched for other management techniques that could assist in solving the complex problems of human organisations and this search has led to the application of tools such as PPBS, ZBB, PERT, MBO, OD, Quality Circles, Strategic Planning and others. It is not possible to discuss all of them and their relative usefulness in the organisation and management of work in the Public Sector in a developing context. We shall, therefore, focus our attention on two of these work organisation methods—MBO and OD.

Management by Objectives

Management by Objectives was first popularised by Peter Drucker (1954) in the United States of America. Since its introduction, MBO has become a very important management tool used by a large number of organisations.

Certain fundamental principles underly MBO as a managerial process. This is because "goal setting" seems to be the "rod of divination" of MBO. MBO also attempts to set goals that are measurable both in quantitative and qualitative terms, and also time-regulated. This makes it imperative for those to whom these goals are set for, to strive towards achieving them and be able to measure their performances or activities within a given time frame. The exclusion of goal-setting, instruments for measuring performance, and limitations of time would reduce MBO to the status of a priceless monument, which at best, could be described merely as an heuristic device postulated to further mystify the proverbial exhortation of the "theory-jungle" of management. But, the careful construction and constitution of MBO as a management technique has made it a "hazel switch for the discovery of buried treasure" in late twentieth century management thought and practice.

MBO attempts to set goals that are measurable both in quantitative and qualitative terms, and also time-regulated.

The importance of MBO as a managerial technique has also been discussed by other management writers. Odiorne (1979) has argued perceptively that "MBO is the dominant form of management in the United States". It may be tempting to question the empirical validity or veracity of this claim, but it seems impossible to question or challenge the popularity MBO has gained as a universal management practice. Indeed, Hodgson (1973) has advanced the argument that "MBO, like ice cream, comes in 29 flavours". This would sound like a caricature but it simply goes to deify an important management tool which is fast gaining institutional status across geopolitical boundaries.Kondrasuk (1981), advances the view that success of MBO appears to dominate failure by a ratio of atleast 5 : 1 and even as much as 10 : 1. Kondrasuk's argument would appear like an exaggeration, but it is merely an expression of an individual's opinion influenced by the geometric rise in the application of MBO techniques in different parts of the world and the institutional status it has assumed, not just as a managerial process but both as a philosophy and technology (Covaleski and Dirsmith, 1981).

In the contemporary Nigerian situation, Ejiofor (1987) argues that MBO is a very useful and important management technique, which if properly conceived and implemented, is likely to lead to organisational efficiency. He further states that MBO "has almost become the 'god' of modern management". Ejiofor also advances the notion that MBO principles are applied in other aspects of life too. The first case which he cites is Odiorne (1965). In the United Kingdom, Humble (1973) was the first to advance MBO principles in the management of work. In Nigeria, the Public Service Review Commission (1974) headed by Chief Jerome Udoji also advocates the introduction of MBO as a cardinal management technique. Apart from its increasing popularity in mainstream management, Perkins (1963) succeeded in introducing MBO techniques in Accounting in a thesis which he referred to as "Accountancy by Objectives". In religion too, MBO appears to have created its indelible imprints, when Sister Miller (1971) gave a soul moving account of the theme "Living by Objectives". Ejiofor (1987) also argues that MBO has been practised in our universities much more than any organisation in Nigeria. He labelled his thesis, "Educating by Objectives". All these views confirm the fact that MBO, whether seen in the light of a management technique, principle or process has an increasing tendency and capacity to survive, inspite of other much more alluring and perhaps newer and more sophisticated management principles.

Organisation Development

Organisation Development (OD) is another management technique or set of strategies that has gained acceptance at the workplace. Though relatively new, OD principles have been described as having the wit and strength to create the necessary honey-comb, if properly conceived and implemented in organisations.

All human organisations have different types of goals — ranging from short, medium, to long-term in nature. Goals are expected to serve as indices to measure performance. Organisations, therefore, make very serious efforts towards achieving these goals, based of course, on some set of predetermined courses of action. Management practitioners particularly, those with strong behavioural science backgrounds initiated new techniques through interventions so as to remove impediments to goal attainment in organisations.

Goals are expected to serve as indices to measure performance.

The purpose of OD is to identify change causative agents, so as to determine problems which may be structured or people-based, and/or are environmentally inspired to enable practitioners, where necessary, to remodel or develop both the structure and human element to suit the changing environment of the organisation. The most commonly quoted definition of OD is that advanced by Beckhard (1969 p. 9) where he stated that it:

> "is an effort (1) planned, (2) organisation-wide, and (3) managed from the top, to (4) increase organisational effectiveness and health through (5) planned interventions in the organisation's processes using behavioural-science knowledge."

This definition appears to have far reaching implications for change management. First, it conceives OD strategies as consciously planned processes which must necessarily be organisation-wide and not to be designed in isolated form. The other aspect of the definition that calls for attention is the fact that OD strategies are to be managed from the top, so as to bring about organisational effectiveness and health, through conscious and planned intervention programmes which border largely or entirely on behavioural-science knowledge. Beer and Huse (1972) have been very critical about the conception that "OD must be planned and managed from the top". Their argument locates its premise of validity from the fact that OD as a set of management strategies, would at least receive top management assent but the process as it is in almost all other human activities that take place in organisations, according to them, "cannot be so thoroughly planned that a complete blueprint is laid in advance". On the basis of this argument, Huse (1980 p. 23) has advanced a definition which merits attention. He states that :

> "Organisation development is concerned with the deliberate, reasoned, introduction, establishment, reinforcement, and spread of change for the purpose of improving an organisation's effectiveness and health."

This definition does not appear to be significantly different from the one presented earlier by Beckhard (1969). Huse (1980) used the expression "deliberate" and "reasoned" in his definition. These two words, though, somewhat different from the term 'planned', also suggest the importance of the planning process in organisations. Planning is a very important tool in management. Before we carry out workplace activities, we have to go through a thought process. This process involves reasoning, and all the decisions we take involve deliberate actions.

Organisation development strategies are growing very rapidly and becoming popular. Some of the reasons for the popularity of OD according to Huse (1980) include the increasing interest and "concern for personal and social issues, the knowledge explosion, and rapid product obsolescence'. The range of settings which OD has been applied is also expanding significantly." In the United States for example, Siegel and Lane (1982 p. 382) have argued that, "OD interventions have been performed in the areas of international relations, higher education, health-care delivery, news media and the military." A very noble scholar in motivational studies has also noted that:

> "OD is winning over a sizeable proportion of the behavioural-science practitioners. According to its supporters, it is alive and well and threatening to have a major influence on many aspects of social design as well as social action (Alderfer, 1977)."

Some of the reasons for the popularity of OD include the increasing interest and concern for personal and social issues, the knowledge explosion, and rapid product obsolescence.

The wind of change in respect of the application of OD strategies has also started to blow across some African countries. Attempts have now been made by some large organisations, particularly, multinational corporations and government owned organisations to introduce OD techniques—Shell Petroleum Development Company (Nigeria) Limited, Nigerian National Petroleum Corporation (NNPC). However, some of these organisations still do not know what exactly they are doing. But behavioural scientists have been using important OD technologies such as Sensitivity training, or T-groups to identify organisational problems. In sensitivity training, the behaviours displayed by members of a group is the focus of study and discussion.

In the industrially advanced countries, other OD technologies such as "Survey Feedback" are used constantly by OD consultants to develop questionnaire(s) to assist these organisations to collect, analyse and interpret data about client-organisations. The interpretation of the data analysed is used as the basis for change in the organisation. The survey feedback questionnaire according to Bowers and Franklin (1977) "typically contains items on job, company, supervisory and pay satisfaction, leadership, job characteristics such as challenge and autonomy, motivation, decision-making, group process, organisational climate, and communication". In the African context, particularly, in Nigeria, this technique has been popular only amongst researchers in higher institutions of learning. The reasons for the localisation of expertise in the use of feedback survey questionnaires in universities and other research institutes appear to be the ostensible lack of knowledge and ability on the part of most management practitioners. Another reason may be the non-availability of reliable data to carry out such scientific studies.

Other researchers in Nigeria have attempted to use process consultation techniques introduced by Schein (1969) as another OD technology. The focus of the process consultation strategy is "to study communication patterns, roles and functions of members within groups, group problem solving and decision making styles, leadership and motivational styles, intergroup co-operation and competition." Although efforts have been made by some Nigerian organisations to adopt this strategy, it has not become popular because the practice of this technique like in the previous case is mostly limited to studies conducted by university scholars mostly for the development of models.

In a recent attempt, Ahiauzu and Chukuigwe (1986) adopted an important OD technology (Job Design) to study the motivational implications of job design strategies in the Banking and Brewing industries in Nigeria. Their study was essentially a seminal effort in the area of job design technologies in studying the effect of the nature of jobs on the behaviour of workers and their reaction to the way the job is designed. These techniques have proved to be very useful in the developed countries, but their use and application in African environments have been very limited.

Apart from MBO and OD, construction firms such as Costain (Nigeria) Limited, Michelletti (Nigeria) Limited, Julius Berger (Nigeria) Limited, and others, have been able to put into extensive use techniques such as PERT and Strategic Planning. However, one limitation in using these organisations as reference points is the obvious reason that they are all foreign companies operating in Nigeria and the core decision making personnel are all expatriates.

The Nigerian Experience

MBO and OD techniques have been successfully applied in a few public sector organisations, particularly, the universities and some nationalised industries in the Petroleum sector, such as the Nigerian National Petroleum Corporation and its subsidiaries in various aspects of petroleum, gas and petrochemical production. While MBO techniques have gained a wider acceptance amongst the universities, OD techniques have been used more extensively in the petroleum industry. The increasing popularity of the use of MBO techniques in the universities can be attributed in part to the fact that there now exist a large number of management faculties and schools in most Nigerian universities. Universities, as centres for excellence and learning possess the necessary technical, professional and intellectual competence to be involved in studies that entail MBO techniques.

The Federal government of Nigeria has just introduced some reforms in the Civil Service based on existing MBO principles. Before the introduction of these reforms there had been areas of visible conflicts and acrimony between political office holders and civil ser-

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vants. Whatever may be the persuasions and preferences of these groups in the governance of the people, the primacy of the State and the supremacy of the national interest is indisputable. National goals and targets are set for national interest. The roles of the various 'actors' that make up the apparatus of government are determined, and all 'actors' are expected to work towards a common goal.

In realisation of this objective, the Federal government of Nigeria set up a Civil Service Reforms Committee (1988). The Committee took both oral and written evidences from various groups, particularly, worker collectivities, senior civil servants, trade union leaders, members of the public and political office holders. Apart from the primary sources, the Committee also used secondary sources, such as official documents, Organisational Charts, participant observation techniques and other sources of data collection techniques to identify the basic problems facing the Nigerian Civil Service. After a thorough analysis of the data at its disposal the Committee was able to identify some areas of administrative conflicts between political office holders and traditional civil servants. The Committee made far reaching changes that are likely to improve the activities of government and those of civil servants. Most aspects of the methodology adopted by the Committee were based on OD techniques. The blueprint developed by the Committee has all the fancies, trappings and principles of MBO. This seems to be a very good example of where both OD and MBO techniques have been used in solving organisational problems.

The Rivers State Government of Nigeria had in the past made attempts to adopt MBO techniques in the management of its ministerial and non-ministerial departments. The low level of success can be attributed to a large number of variables. These variables, among others, include lack of necessary skills to put into use these techniques, economic and socio-cultural considerations. One major reason why MBO techniques have not created the desired impact in most of these organisations is the apparent lack of goal congruence between top managers who set the objectives and those who implement them. Ejiofor (1987) has consistently argued that the goals of the organisation are not shared in most cases by subordinates. MBO as a management technique cannot prove useful in such a situation where there is plurality of objectives.

Another remarkable feature that had in the past crippled MBO practices is the setting of goals that are not achievable. In most public sector organizations in developing countries, particularly Nigeria, very ambitious goals and objectives are usually set, without taking into account the resources at their disposal. The success of MBO programmes depended largely on the technical competence of both the designers of the objectives and the executors. They must possess the necessary skills and know-how to be able to understand the full implications of MBO as a tool for achieving efficiency in an organisation. But these vital elements, more often than not, are usually missing in organisations in developing countries that have attempted to use MBO techniques in organising work.

One of the critical and success factors in any modern workplace is an efficient and effective communication network. Organisations exist in a total social system. Members of these organisations, therefore need to have regular interaction among themselves. The interactional processes usually take the form of communication. But organisations in most developing countries suffer very seriously from lack of communication facilities. Less complicated communication devices such as telephones, wireless radios and others are still not properly developed in most developing countries. The situation in Nigeria is equally chaotic. MBO as a work organisational method cannot record any appreciable degree of success in the light of such a poor state of communication network.

One major reason why MBO techniques have not created the desired impact in most organisations is the apparent lack of goal congruence between top managers who set the objectives and those who implement them.

MBO as a work organisation method does not also seem to have received general acceptance by all those who are involved in it. A preponderant number of employees are used to doing things in the "old way", therefore, innovations or new methods or ways of doing things seems to be an anathema to such persons. MBO programmes that have been well conceived in the past

have suffered from the refusal of employees to accept new techniques of organising work.

There are other identification cultural factors that have impeded the introduction and successful implementation of MBO techniques in most organisations in Nigeria. Based on detailed ethnographic information on the mode of work organisation in African workplaces, it has been established by Ahiauzu (1985a, 1985b, 1986) that the African worker has adopted management practices which are quite different from those of his Western counterpart. Ahiauzu has argued that the African worker has developed over the years work organisational methods based on his "thought-system" which is ostensibly different from his Western counterpart because "they evolve from the unique circumstances of the African societies, and were based mainly on the philosophies and world-views of the African people".

Management techniques such as MBO and OD are good both in design and concept but they appear to possess traits which can be described as traditional American middle class work norms. Because these work organisational methods have created a dual role for the African worker, it seems he has become somehow confused as to which methods to adopt at workplace. Ahiauzu (1983) in one of his fieldworks came across a factory worker who described his experience on his first day at work, and said:

> "When I went home at the close of work that day, I told my wife that if she saw the machines at the factory, she would see where the whiteman's witchcraft did a great work."

MBO as a work organisational method cannot record any appreciable degree of success in the light of such a poor state of communication network.

Ahiauzu went on to argue that:

> "The African worker is therefore constrained to live daily, two different patterns of life, with different specific sets of values, social norms, communicative symbols and patterns of human relational processes, and general systems of what Hofstede (1980) would call mental programming."

The Nigerian worker as a result of the low level of development around him and the sudden imposition of management theories and principles based on Western ideas and philosophies appears to have been caught between the "hammer and the anvil". Because of the total confusion in which the Nigerian worker had been thrown into, he now manages two worlds of work—a world of work based on traditional African thought system and a world of work based on Western management principles. If the African (Nigerian) worker is entrapped continuously in this type of situation, it will become increasingly difficult for Western-based work organisational practices, such as MBO and OD to create any significant impact in most African (Nigerian) workplaces.

A few public sector organisations where MBO and OD have proved successful to a point appear to be the universities and research institutes in Nigeria. This seems to be so as a result of the level of Western education which the operators of universities and research institutes have received. Most policy makers and executors in almost all Nigerian universities and research institutes have received their education from Western countries. They have imbibed Western work ethics and traditions which apparently, have coloured both their behaviours and thought system. In fact, some of these managers who received their education in Western countries have been described by Ake (1979) as persons whose intellectual orientations have made them more Western than the Westerns themselves. But the problems still remain because a very large proportion of workers in these organisations who did not pass through the "Western mill" may still be ignorant of the aims and objectives of MBO and OD.

Another reason why MBO and OD techniques have had limited impact in most workplaces, has its origin from the Nigerian manager whose orientation centres around western management thought. We have argued elsewhere (Johnnie, 1988e, 1989) that such managers are now struggling to unlearn some of the Western-based work organisational methods to enable them relearn African work management techniques. As long as African managers continue to get themselves acculturated with Western work traditions and ignore African work norms, MBO and OD technologies introduced at African workplaces will take considerably long to be assimilated by lower level employees.

A major problem which has militated against the installation of MBO and OD techniques in most organisations in developing countries is the economic outlay involved in the installation process. MBO and OD are not mere policy or procedural changes in organisations. The installation of MBO and OD involves not only economic resources but also entails both human and other material resources. MBO and OD are strategies that involve

major structural changes, affecting the totality of the method of work organisation. This can have far reaching economic, social and political consequences on productivity. MBO and OD techniques would have had stronger inroad in most workplaces in developing countries, particularly, Nigeria if their installation involved less economic costs.

MBO and OD techniques would have had stronger inroad in most workplaces in developing countries, particularly, Nigeria if their installation involved less economic costs.

Conclusion

Over the years there had been increasing calls by management experts for the production of new management techniques in modern workplaces. The introduction of any new technique (s) of work organisation, particularly in developing countries requires a rather slow and cautious approach. Our level of development is still very far from the countries of the West. It is, therefore, unthinkable for us to move at the same pace with the industrially advanced countries. It took these countries many years to get to where they are today. Therefore :

* Work organisational methods in developing countries should move *pari pasu* with their level of development and education.
* Work organisational techniques based on American and European middle-class work norms should not be forced on workers in developing countries, rather they should be made to go through a gradual process of acculturation.
* While introducing Western-based work techniques and methods, the values, beliefs and norms of workers in developing countries should be taken into account, instead of "desecrating them overnight."
* A point of convergence should be established between Western work values, traditions and those of workers in developing countries.

No doubt there exists areas of divergence between Western management-thought and thought-system of workers in developing countries, in relation to their mode of work organisation. However, since the world has become a "global village', it is necessary for management scholars, and practitioners to conduct more purposeful and result-oriented studies to identify areas of seeming contradictions, in terms of work organisational techniques to enable workers in both developed and developing countries to operate reasonably well with ideas from environment other than theirs. This will definitely bring about a quicker way of assimilating work organisational techniques based on the beliefs, traditions and precepts of the industrially advanced countries by workers in developing countries.

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Privatisation Experiences: Lessons for Developing Countries

Nand Dhameja

The global economic scenario is undergoing dynamic changes and privatisation is being increasingly resorted to as the panacea for the malaise in developing countries. The author presents the experiences of such ventures in the U.K. and the Latin American countries for lessons to be gleaned by nations aspiring to emulate the model.

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Privatisation has attracted considerable attention recently and reflects a world-wide interest in reduction of the state's role in national economies, at the same time enhancing the role of private sector either by private ownership or by introducing market and competitive forces in state operations. The three main overtures of privatisation are:

* Change of ownership from the public to the private sector;
* Liberalisation or deregulation of entry into activities previously restricted to public sector enterprises
* Provision of goods or services transferred from public to private sector, while government periodically monitors performance and efficiency of operations.

In India, there have been attempts to privatise public enterprises as well as public utilities and other services like, power sector, banks, public works, tourism, local road transport (Dhameja, 1991). There has been liberalisation of government policies inviting private participation in financing of various public utilities.

Industrial Policy announced by the Govt. has beed designed "to unshackle the Indian industrial economy from the cobwebs of unnecessary bureaucratic controls". Various measures of liberalisation announced include:

- Industrial licensing abolished for all projects except for a short list of industries of security and strategic importance.
- Opening all manufacturing activities to competition and abolishing the monopoly of any sector or individual enterprise in any field of manufacture except in strategic areas or for military considerations.

- Direct foreign investment raised from 40 per cent to 51 per cent without any bottlenecks.
- Automatic permission for foreign technology agreements in high priority industries.
- Liberal provision for hiring foreign technicians, foreign testing of indigenously developed technology.
- Disinvestment of Government holdings in Public sector units (PSU) with the objective to raise resources and encourage wider public partciation. The Government has disinvested shares of 31 PSUs in two phases through UTI and financial institutions and has collected more than Rs.3000 crores which account for only eight percent of the shares of these PSUs. After the listing of the shares in the stock exchanges, such shares are placed in the market for trading. It is reported that the Govt. has decided to disinvest more shares upto 49 percent of the equity shares of PSUs and has invited tenders.
- Chronically sick public sector units have been referred to the Board for Industrial and Financial Reconstruction (BIFR) for the formulation of their revival.
- MRTP Act has been amended and the MRTP threshold for asset limits has been abolished. Emphasis is on controlling and regulating monopolistic, restrictive and unfair trade practices.

This paper discusses the privatisation experiences of the U.K. and of Latin American countries like Mexico and Argentina. The U.K. and the Latin American countries have been selected as the former has been the pioneer in the path of privatisation which has engulfed giant organisations in the latter.

Privatisation in U.K.

In 1982, public enterprises in U.K. accounted for about 11 per cent of gross domestic product at factor cost. Privatisation process in U.K took the form of denationalization and deregulation and it obtained support from Government and Conservative manifesto in 1987. Though privatisation phenomenon in UK is associated with post-1979, Conservative government and with Thatcher economics, Thomas Cook, Rolls Royce car division are some of the cases of privatisation during midseventies. A White Paper issued by the Government argued that privatisation would provide autonomy, protect from fluctuating political pressures, encourage competition and would ensure benefits of greater efficiency.

Objectives : The objectives of privatisation are broadly categorised as political, exchequer and efficiency. Conservatives under the leadership of Thatcher were able to privatise a number of enterprises, and thereby pass on assets from the state to private individuals.

Sales proceeds from the divestiture of public enterprises in order to improve the financial position of the government has been another objective of privatisation. Accordingly in the early eighties, the emphasis was on the divestiture of profitable public sector companies that could be sold easily and quickly. The public floatation of British Telecom in 1984, was the first public utilities to be privatised in the UK, and was the largest floatation in the world. Special regulatory arrangements had to be made to control possible abuses of monopoly power and to maintain supply and service standards. By 1986 'Popular capitalism' had become one of the main objectives of privatisation.

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There have been more than forty three cases of privatisation since 1977, and they resulted in share proceeds worth hundreds of billion dollars. Some have been piecemeal transferred to the private sector e.g., British Petroleum Co., British Aerospace, Associated British Telecom. Cases where enterprises have been sold by public offer, have yielded £ 26 bn. Many have been public sales, while several others have been in the nature of private sales including management buy-outs. Table 1 shows major public offerings, while third party sales (TPS) including management buyout are shown in table 2.

Privatisation through public sale of shares adopted different techniques of placement of shares, namely:

* Offer for sale at a *fixed price*. for example, Associated British Ports: British Telecommunications, and British Gas
* Sale by tender, with a *minimum price*: For example, Associated British Ports, second issue; British Petroleum.

Table 1 : Privatisations and Public Offerings (1977 to Date)

Company	Date of sale	Gross Proceeds			
		Sold %	Company £m	Government £m	Total £m
Amersham International	Feb. 1982	100	6	65	71
Associated British Ports	Feb. 1983	51.5	56	(34)	22
	April 1984	48.5	—	52	52
BAA	July 1987	100	—	1,281	1,281
British Aerospace	Feb.1981	51.6	100	50	150
	May 1985	59	188	363	551
British Airways	Feb. 1987	100	—	900	900
British Gas	Dec. 1986	97	(2,286)	7,720	5,434
British Petroleum	June 1977	17	—	564	564
	Nov. 1979	5	—	290	290
	Sep. 1983	7	—	566	566
	Oct. 1987	36.8	1,515	6,502	7,017
British Steel	Dec. 1988	100	—	2,500	2,500
British Telecom	Nov. 1984	50.2	1,290	2,626	3,916
Britoil	Nov.1982	51	—	549	549
	Aug. 1985	48	—	449	449
Cable & Wireless	Oct. 1981	50	35	189	224
	Dec. 1983	22	—	275	275
	Dec. 1985	31	331	602	933
Enterprise Oil	June 1984	100	—	392	392
Jaguar	July 1984	99	—	294	294
Rolls-Royce	May 1987	100	283	1,080	1,363
			1,518	26,275	27,793

* The percent sold will not total 100% due to rights issues and shares retained for loyalty bonus for employees.

Source: Price Waterhouse

(Reproduced from : Accountancy November 1989)

* Offer for sale and sale by tender: For example, BAA sold shares at a fixed price of 245 pence also tender applications were accepted in full and at the price tendered.

The public issues were underwritten with the commission varying from 0.5 per cent to 13.6 per cent of gross proceeds, and had problem areas—shares were offered at prices reported to be relatively low in the early cases and thus the interests of the public exchequer had been subordinated to the prime objective, namely successful sale to the private sector.

Some considerations of privatisation have been to reduce government interference, to increase efficiency and to expose sheltered industries to market disciplines, to increase competition and to promote wider share ownership (Peter, 1989).

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Does privatisation improve efficiency? Who benefits from improvements in efficiency: consumers, employees, shareholders or Govt? There is no one answer to such questions. Many efficiency gains would in principle be achievable even if the ownership is retained by the Government. However, efficiency improves by change of ownership to private sector primarily due to autonomy of managers and introduction of competitiveness in the economy. For example, a sharp reduction in British Telecommunication's waiting list for new connections immediately after privatisation, was hailed as an evidence of the favourable impact of divestiture. However, after complaints of poor service it was considered that BT was abusing its monopoly and suggested that giant organisations be split up and greater competition be introduced before privatisation.

However, the various objectives of privatisation may conflict and considerations of increased competition, reduction in government interference, or wider share ownership have not been achieved in a number of privatisation cases, the possible reasons being the following:

* Privatisation has left the pre-privatisation sizes and monolithic organisations undisturbed. For

Table 2: Prevatisation — Third Party Sales and MBOs (1979 to Date)

	Date	Method	Gross Proceeds £ m
British Shipbuilders Warship Yards			
Brook Marine	May 1985	MBO	(b)
Yarrow Shipbuilders	June 1985	TP	34
Vosper Thormycroft	Nov. 1985	MBO	18
Swan Hunter Shipbuilders	Jan. 1986	MBO	5
Hall Russell	Mar. 1986	TP	Not disclosed
Vickers Shipbuilding & Engineering	Mar 1986	MBO	60(a)
Scott Lithgrow	Mar. 1984	TP	12
Govan Shipyard	Aug. 1988	TP	N/A
Clark Kincaid ltd	Dec. 1980	TP	N/A
Appledore Shipbuilders Ltd.	Jan. 1989	TP	N/A
British Technology Group (NEB)			
ICL	Dec. 1979	TP	37
Fairey	June 1980	TP	15
Ferranti	July 1980	TP	43
Inmos	Aug. 1984	TP	95
National Bus Company	Aug. 1986 Mar. 1988	MBO/TP	325
National Freight Company	Feb. 1982	MBO	7
Rover Group			
Unipart	Jan 1987	MBO	30(a)
Leyland Bus	Jan. 1987	MBO	4
British Leyland Trucks	Apr. 1987	merger	none
DAB	May 1987	MBO	7
Istel	June 1987	MBO	26
British Rail			
British Rail Hotels	Mar. 1983	TP	45
Sealink	July 1984	TP	66
Doncaster Wagon Works	Oct.1987	MBO	N/A
Horwich Foundry	Aug. 1988	TP	2
Travellers Fare	Dec. 1988	MBO	21
British Rail Engineering Ltd	Apr. 1989	MBO/TP	14
British Airways			
International Aeradio	Mar. 1983	TP	60
British Airways Helicopters	Sept. 1986	TP	14
British Gas Wytch Farm	May 1984	TP	80(a)
Royal Ordinance			
Leeds tank factory	Oct. 1986	TP	15
Remainder	Apr. 1987	TP	190
Rover Group	Aug. 1988	TP*	
Yorkshire Rider	Oct. 1988	MBO	23
National Seed Development Organisation	Sept. 1987	TP	66
General Practice Finance Corporation	Mar. 1989	TP	145
Busways	May 1989	MBO	14
Short Brothers	June 1989	TP	30
Redpath Dorman Long	May 1982	TP	N/A

a) Initial proceeds only; additional proceeds contingent on future activity for Vickers (£ 40m) Unipart and Wytch Farm (£ 135m plus profit share)

b) Proceeds £100,000

MBO = Management buy-out(including management/employee consortia)

TP = Sale to third party

TP* = Sale to third party after cash injection of £ 547m

N/A = Information not available

Source: Price Waterhouse

(Reproduced from : Accountancy - Nov. 1989)

example, British Gas, British Telecommunication, British Airways and BAA Inc. remained monopolies and a single large complex. In fact, the Government has initiated steps to introduce competition and has created new bodies to regulate it.

* Doubts were expressed on the adequacy of the regulatory machanism as applied to industries privatised. For example, with reference to British Gas, it had been observed that the regulatory framework hardly seemed adequate to control such a powerful and dominant industry (Price, 1986)

* Though privatisation is reported to have resulted in widespread increase in share ownership evolving capital owning democracy, with one in every five adults holding shares, the Government did not get the maximum revenue from the sale of shares as they were offered at prices attractive to the purchasers. Further, certain questionable trends emerged in share ownership:

* There has been a substantial reduction in the number of small shareholders in certain cases. For example, in British Aerospace, the number of shareholders reduced from 44062 to 3279 within a year after its floatation in the 0 - 99 shares category, from 81558 to 12849 in the 100-499 shares category.

* Small shareholders, in the aggregate, accounted for a very small percentage of equity of the companies privatised; hence privatisation does not seem to have reduced skewness in corporate ownership.

* Issue of shares at concessional price to employees and pensioners, raises the question of inequality in income and wealth distribution. Though the practice of shares issue in private sector is the decision of the owners to give certain benefits to employees, in public enterprises, it would result in passing public money (or tax payer's equity) to employees at concessional rates. The employees in public enterprises, particularly so in India, are in higher income brackets than the workers in the unorganized sectors. If the former being entitled to concessional allotment it would enhance disequilibrium of income and wealth.

Privatisation of Water Authorities in UK

The Government privatised water collection and distribution system, as well as collection, treatment and disposal of sewerage. The sale of ten water companies in England and Wales in November 1989 brought in about £7 billion, the net proceeds to the government being small (Accountancy, September & December, 1989). Salient features of privatisation of water authorities were as follows:

* Debts of water authorities amounting to £ 4.9 b. were written off before sale.
* The Government agreed to inject £ 1.2.b. cash (the so-called green dowry) to cover £ 300 m. of external third party debt and to help pay for environment improvement.
* Thus the water authorities began life in the private sector free of debt, but were required to incur heavy capital expenditure to meet improvements demanded by the government. The capital spending would total £18,65 b. over ten years and more than £ 30 b. over the next twenty years, and this would be met mainly by borrowings.
* Formula for average price increase of 5 per cent above the rate of inflation was agreed upon.
* Shares of 250 pence each were issued, the amount being payable in three instalments: the first instalment of 100 pence; the second and the third instalment of equal amount, the final payable in July 1991.
* About one-sixth of the shares were offered to overseas subscribers, and between 25 per cent and 50 per cent made available to public. About one - third of the public shares were for preferential allocation to registered consumers.
* Individual customers received a discount of about 8 per cent on the total amount payable for the shares. Alternatively, they could receive a one for 10 bonus upto a maximum of 7500 fully-paid, provided they hold the shares allocated in the offer for three years.

The water companies published their first annual reports and accounts since privatisation in November 1989, and the profit before tax achieved compared quite favourably with the forecast given in the offer for sale (Accountancy, October 1990).

Privatisation of Electricity Industry in UK

Since 1957, all the power had been generated by the Central Electricity Generating Board (CEGB) and transmitted by the national grid to 12 local boards which distributed to domestic users and businesses.For privatisation the electricity industry was separated into companies specialising in the three main functions: generation, supply and transmission. Transmission was handled by a new company called the National Grid. The 12 local distribution companies were the first to be floated in December 1990. The Central Electricity Generating Board (CEGB) involved in generation had been dismantled and split into two companies—National Power and Power Gen.

National Power, the largest power company in U.K with 35 power stations having £4bn. plus turnover and about 60 per cent of the non-nuclear capacity in England and Wales was privatised with 40 per cent of the stake retained by the Government (David Thomas, January 1991). The privatisation deal was constrained by a transitional insurance policy having assured coal supply by British Coal. It was estimated that privatisation of National Power would yield the following:

* Cost cutting by target shedding 5000 jobs over the next 5 years, and by closing down high cost power stations.
* Fuel strategy to have combined cycle gas turbine plants which are quicker to build, easy to operate, cheaper and more environmentally friendly. Planned gas stations are likely to cut fuel bills, which account for 2/3 of total cost, and to reduce dependence on high cost British coal through more imports.
* Diversification plans including upstream' move into fuel production by joining consortia bidding for North Sea gas exploration permits and investment in foreign coal production; or `down stream' move by developing energy management services for large industrial customers.
* Privatisation of 12 distribution companies in December 1990, involved £ 5.2 b attracting 12.75m. applications from 5.7 m. people, and it was reported to be the most popular privatisation ever (Adele Ward, January 1991).

Two Scottish electricity companies were privatised by offering shares at most generous incentives to Scottish customers, though the opinion poll in 1988 had

indicated that privatisation would lead to worse service to customers and would be bad for the company (Financial Times, March 25,1991.)

The new structure of the industry makes electricity like any other commodity prone to competition. The generators compete with each other to sell to a pool managed by the National Grid, and the local electricity companies no longer have a monopoly in selling to customers in their areas as the generators are allowed to bypass the cool and sell directly to the user. Similarly, to inject competition into the privatised electricity industry in Scotland, the authorities envisaged a range of measures including reserving market share for companies other than Scottish companies, weakening the grip of Scottish companies on the inter - connector with England and enhancing the role of Scottish Nuclear.

As most of the utilities in U.K have been privatised as highly profitable monopolies the authorities were faced with the tasks to prevent the monopolies from abusing their power over consumers and to explore and encourage competition which promotes consumer choice. Authorities were thus concerned with price and quality of service (Financial Times, March 13, 1991).

Privatisation of Technology, Hospital Services & Local Govt. Services

Besides public sector units and utilities privatisation in U.K. has engulfed technology and insurance services. British Technology Group (BTG) having considerable legal and technical skills in securing intellectual property rights for its inventors and dealing in the esoterics of technology transfer, is to be privatised. In order to introduce competitiveness, the UK Deptt. of Health and Social Security contracted out three specific hospital services namely catering, cleaning and laundries. Services such as refuse collection, street cleaning, ground maintenance, vehicle maintenance, cleaning and waste disposal were contracted out.

Privatisation & Employee Motivation

Benefits of privatisation programme are the mopping up of resources and increased involvement and motivation of employees of privatised companies through share ownership. In this regard, a confederation of British Industry Survey revealed that 80 per cent of the companies with employee share-ownership scheme did think that they motivated the workforce.This survey however, relied on the opinions of company chief executives.

Benefits of privatisation programme are the mopping up of resources and increased involvement and motivation of employees.

Another survey funded by the Economic and Social Research Council, involving 255 employees of a privatised utility, revealed the viewpoint of employees of companies privatised. Results of the preliminary survey are (Financial Times, March 7,1992)

- More than 90 per cent of employees, including manual workers owned shares in the company, but the survey found little to support the government's claims about employee motivation.
- Nothing suggested that share ownership had changed the attitude of manual workers towards the company. In fact, 77 per cent of the manual workers denied that ownership of shares made employees more careful with company equipment, material and time. The same number denied that shareholdings made employees work harder.
- The view that employee share ownership replaces "us and them" attitude with a sense of common purpose was rejected by 87 per cent of manual workers and 94 per cent of management.

Privatisation in Latin American Countries

Many of the Latin American countries as a measure of economic reform, have planned to sell off their uncompetitive and money-losing enterprises to private hands. Chile has had an active and successful divestiture programme since mid. 1970 covering electric utilities, telecommunications, airlines, water supply, oil exploration and insurance. Chile and Uruguay adopted deregulation of industry, privatisation of commercial banks and complete freeing of interest rates on bank deposits and loans with the objective of economic reform and to end inflation. Such efforts on privatisation and deregulation ended in failure with building up of foreign indebtedness and government intervention.

Privatisation in Mexico

Mexico announced plans to reduce the number of state enterprises from 1155 to 200 through mergers or

divestiture. Airlines, copper mining and telephone have been handed over to the private sector. As a fundamental component of economic reform, the public sector has shrunk and the private sector has expanded. The Government announced the privatisation of banks on May 2, 1990. The banks have been in the hands of the government only since 1982. During this period, the government used bank reserves to finance the public sector deficit and the banks neglected their core business of lending and attracting deposits (Mexico, Euromoney, 1990) The state owns about 66 per cent to 75 per cent of bank shares and the balance is traded in stock market. The Government has invited bids for 51 per cent of shares from Mexican citizens having appropriate expertise and capital. Response to acquire shares is immense, however, the sell-off programme could take 18 months to two years.

Privatisation in Argentina

Privatisation process was initiated in Argentina as a part of economic reforms launched by the new government in July 1989. Argentina which has had 38 administrators in 40 years had been subsidizing industrial investment and utilities whose inefficient operations and mismanagement have wrecked the country's public finances and distorted the economy for decades. Privatisation in the form of denationalisation was a step to shift Argentina from a highly regulated subsidized economy to one that is market-driven and open to international business houses. A distinct feature of privatisation in Argentina had been that giant state enterprises have been divestited. Such enterprises include telephone company, international air carrier, railroads, highways, oilfields, sugar plant, shipping company, railways, tourism, TV and radio stations, coal company, chemical enterprises, and military owned companies. The enterprises have been offered to domestic and foreign companies adopting the practice of debtswaps whereby the foreign company assumes obligation of Argentina's debt. Privatisation faces opposition from vested interests like employees and charges of selling too cheap by critics. However, it has widespread popular support. People are in favour of the private sector and foreign investment, with the expectation that it would bring in new jobs. Privatisation, in some cases, is complicated by technical factors, like delay in obtaining waiver from foreign banks, creditors allowing sale of business and assets. Further, the issue of pricing of products or services after privatisation is troublesome, particularly where a substantial indirect tax levy is included in prices and prices are not based on commercial principles of demand and supply or cost of providing goods and services (Peagam Norman, 1990). Particulars of some of the enterprises to be privatised are given in Table 3 (Economic Times, Oct. 4,1990).

Privatisation in the form of denationalisation was a step to shift Aregentina from a highly regulated subsidized economy to one that is market-driven and open to international business houses.

Telephone Company: Entel, the telephone company had more than 40,000 employees, operated Argentina's local, long distance and international telephone services, and had over 3 million active lines in service. During 1989, the company reported a loss of $ 1.5 billion on revenue of less than $ 1 billion. In these circumstances, bidders were really tendering for Entel's plant and equipment and its licence,representing an initial monopoly franchise which might produce attractive returns if the company is run more efficiently. The plant and equipment were officially valued at $1.9 billion. The authorities split the company into two parts on geographical lines, invited bids for 60 per cent of each new company from international telephone concerns. Ten per cent was offered to employees, five per cent to private telephone cooperatives (which will go out of business) and 25 per cent to the public. These two companies would be managed by foreign companies, finalized on the basis of bids. Payment for both the parts was agreed at $ 594 million cash and taking over of Argentina debt paper with a face value of $ 5 billion having a market value of $ 750 million (Since Argentina, debt is traded at 15 c a dollar). Privatisation of telephone companies would have wider public ownership and 200,000 Argentine shareholders were expected.

The bid was for the plant and equipment of the company and its licence. Thus each new company (bidder) gets the following:

i) Permanent licence which provided for a two-year transition period,

ii) Thereafter monopoly rights for a five year period to provide telephones in their regions.

iii) Option for a further three years of exclusive service, after which competition would be permitted. Other terms of privatisation included:

Table 3 : Privatizing Argentina's State-Run Business

Company or Industry	Type of Activity	Principal buyers	Price
EntelsR	Telephone System Techint (Argentina)	Citicorp.Telefonica Noteds (Spain)	$ 316 million cash & $ 27 billion debt swaps
Entelnor	Telephone System	Manufacturers Hanover Trust Bell Atlantic	$ 278 illion cash and notes $ 28 billion debt swaps
Aerolineas Aergentinas	International airline	Iberia Airline (Spain) Cielos del Sur (Argentina)	$ 260 million cash and notes $ 2 billion debt swaps
Oil fields	Secondary recovery from small fields Production in four major areas	28 contracts awarded to Texaco Occidental others Amoco, Royal Dutch/Shell 21 others plan to bid	$ 253 million cash $ 1 billion (est)
6.000 miles of highways	12-year concessions to operate toll roads	40 operators mostly construction companies	Promise to invest $ 1.2 billion
RosarioBahia Blanca RR	30-year concession to operate 3,250 mile network	Techint (apparent high bidder) low Q Interstate RR	Plan to invest $ 500 million: annual tract rental rises to $ 1.5 million after 10 years

(*Source*: Economic Times, Oct. 4,1990)

i) New companies were assured a real return of 16 per cent (before taxes and interest) on the official gross value of the assets, otherwise they could trigger tariff adjustments in order to reach 16 per cent.

ii) In case, the return exceeds 10 per cent they must refund the surplus.

iii) After two years, the new companies must reduce tariff by a real weighted average of 2 per cent a year over five years in order to maintain their monopolies.

iv) To exercise their option for a further three years of exclusive rights, they were required to reduce tariffs by 4 per cent a year so that, after 10 years, real weighted average tariff should be 80 per cent of the original level, thus passing efficiency gains onto customers.

v) New companies were under no obligation regarding the level of employment or investment. However, further investment of $5 billion over 10 years was envisaged to expand services in some provinces.

Airlines: The International Airlines was planned to be privatised by selling it to Iberian Airline of Spain with $130 million cash, $130 million in instalments over ten years. and $2 billion worth of debt for 85 per cent of the deal. The principal buyer pledged to invest $ 683 million in the Airlines to buy 15 new aircrafts and improve the installations.

Oilfields: Oilfields exploration and production rights by the state company were auctioned and the initial round of bidding for small marginal fields brought in $253 million from Argentine and foreign oil companies. Next batch of bidding in more productive areas in March, 1991 was expected to yield nearly $ 1 billion joint venture contract with the state company. Private oil producers would be free to sell their output either in Argentina or abroad.

There were plans to allow private companies to operate services such as highways and railroads. Recently 12 year concessions to 40 bidders, mostly construction companies were awarded to operate 6000 miles of highways. Further, 30 year concessions to rebuild and operate 3250 miles of nearly defunct main-lines and feeder rail-lines were awarded to the highest bidder—Argentina's Techint, a steel making and engineering group.

In short, by privatisation, Argentinian companies are tapping the hoards of dollar reserves, the national debt has been swapped and a recovery of business confidence is expected in Argentina.

Lessons for Developing Countries

Privatisation is not necessarily divestiture or denationalisation. It may also cover reorganisation, without necessarily parting with equity ownership and may take forms like holding company form of organisation, leasing out, licensing, or handing over managment, or liber-

alisation by introducing market criteria. The form of privatisation would depend upon, besides the nature of government activity, the purposes of privatisation. The following could be the lessons for the developing countries for working out strategies for privatisation.

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Role of Public Sector

Share of public sector in the economy is one determining factor for the form of privatisation to be adopted. For example, in the U.K. public sector accounted for about 11 per cent of GNP in 1981, while in the U.S., the corresponding figure was 1 per cent. Accordingly, in U.K. privatisation mainly took the form of divestiture of public enterprises, while in the U.S. it look the form of liberalisation and deregulation, also called partial privatisation' of various services provided by the government. Privatisation of public enterprises has been insignificant in the US, and has predominantly been in the area of contracting out public services, urban services like garbage collection, wastewater sewage treatment, solid waste disposal, public transport, fire protection, child welfare, health, and maintenance of prisons.

In India, the public sector accounts for a sizable part of GNP, so privatisation could take the forms of denationalisation of public enterprises, and also of deregulation of services provided by the government. Further, for public utilities or services provided by government department like, drinking water supplies, sewerage, power sector, road, communication, bridges, etc,. private sector may be associated to finance the project, operate it to recoup the investment made, by recovering fees or charges for the services provided. Since such services have a long gestation period, and involve huge investments, the period of lease contract, called affernage may be longer, say 20 to 30 years. In India, Govt. has decided to invite private sector participation in power sector and the licence period has been extended to thirty years.

There is also a constant need to monitor the service, and to lay down norms for rate of fee fixation, or for further investment, in the interest of the consumer and the private sector for its investment. Partial privatisation might represent a substantial gain in efficiency (were it only for the discipline instilled by having the private party represented on the board of directors), while safeguarding government's concern for strategic control (Charles Vuylsteke). Recently, British Government has launched the citizen charter to check the post office monopoly by allowing competitors to enter the market for letters costing less than £1 to deliver; and a package has been designed to strengthen the regulation to control telecommunications and gas industries to compensate customers for poor service (Financial Times, July 27/28, 1991). Similarly, in order to retain control over matters such as the level of foreign ownership or subsequent changes of ownership or to prevent unwanted takeovers and to ensure British dominance of the Board,in cases where the Government has sold 100 per cent of the equity, like Rolls-Royce, the Govt. has retained a special share the 'Golden share'. Thus, the arrangement which works through the Articles of Association of the Company provides the Govt. with a power of veto over specified matters.

Further, the interdependence of various sectors or atleast the downstream effects of privatisation of one sector over another need to be clearly analysed. For example, electricity generating industry in the U.K. buys 95 per cent of its coal requirements nationally, (at prices higher than the world spot price for foreign coal), privatisation of electricity generating industry has major downstream effects on sale of coal, including assured supply of coal, hence the need for privatisation of coal industry (Charles Vuylsteke).

Privatisation has led to conflict between macro and micro economic objectives, as a public sector unit can lobby for more funds just as a Government department or other public sector units, though all this has perforce to fit within the treasury's objective of public expenditure and many a sound project may get dropped or postponed. On the other hand, an enterprise after privatisation has greater commercial and financial freedom and can look for private funds for its expansion or growth on its merits. This has been an argument for the privatisation of British Rail (David Sawers, Financial Times, 21 March, 1991).

Organisational Form & Financial Records of Public Enterprises

Statutory Corporations and Government Departmental Undertakings, would require necessary change in the concerned statute for purposes of privatisation, as the privatisation process becomes simpler in a joint stock company form of organisation.

The timescale for the sale of British Telecom illustrates the point. British Telecom was decoupled from the Post Office long before the idea of privatisation was even mooted. The timescale was as follows:

The Post Office, formerly a government department became a public corporation in 1969.

- Government announced its intention to sell a majority of shares by public floatation in 1982.
- British Telecom was formed as a company wholly owned by government in summer 1984; and in November 1984, 50.2 per cent of the shares were sold.Further, the financial condition of public enterprises is the factor for determining to whom, according to what method, and at what price these might be sold.

Privatisation in the form of divestiture or any other form would not be problematic for public enterprises with strong performance records or with good financial conditions as the purchaser would find the deal attractive. However, in many cases the Government may have to pump in financial resources for the smooth running of the public enterprise, for example, government agreeing to inject £1.2.b. cash (so called 'green dowry') for the privatisation of water companies in U.K. Thus privatisation with the objective to mobilise funds covers the sale of profitable enterprises.

Privatisation with the objective to mobilise funds covers the sale of profitable enterprises.

On the other hand, public enterprises with weak financial conditions and poor records of performance may not be saleable "as is", and would require financial restructuring. In many cases, accounts maintained under some local social laws may have to be recasted on sound financial principles to diagnose and analyse financial conditions, more so when foreign participation is expected. Hungary can be cited as an example. Further restructuring of capital structure or debt may warrant rescheduling of debt repayment or conversion into equity. In case rescheduling of foreign debt is required waivers for foreign creditor bank would be needed for sale of business and assets. Scuh waiver sought may be either a blanket waiver to cover all debts of various firms to be privatised or a specific waiver covering the particular case. Foreign creditor banks may refuse such blanket waiver, or use this opportunity to ask for higher interest payment in return. For example, the request for blanket waiver by Argentina had been refused while a request by Brazil was accepted. Financial restructuring may be drawn prior to divestiture or be left to the purchasing party. This would require finalisation of privatisation terms attractive to the private sector without adversely affecting the interests of the Government.

Restructuring would also require assessment of investment required and the likely return. For this purpose the help of a merchant banker is sought to determine the methods of privatisation terms, timing and pricing of the issue. Informal evaluation of overall potential and possible alternatives for privatising certain unprofitable enterprises is a key element for governments to confirm whether an enterprise is a potential candidate for profit through sale (Charles Vuysteke). In loss making enterprises, liquidation and sale of individual assets or management contract or lease may be alternatives for mere divestiture.

Samuel Paul (1985) writes, "divestiture is the least palatable of the three methods to LDC governments. An alternative likely to be more attractive is the leasing of state owned enterprises or the use of private management contract to strengthen exclusively, enterprises whose turn around seems feasible". Many countries, as a policy have retained loss making enterprises and profit making ones have been open to private investments which again further bleeds the governments' already nebulous finances. On the other hand, in many countries, loss making units have been privatised by outright sale or by sale of individual assets. In India, chronically sick public enterprises have been referred to the BIFR for revival programmes and the shares of profit making public enterprises have been sold to mobilise resources for the Govt.

Domestic Strength of Financial Market

Divestiture and sale of enterprises to private sector requires developed capital market, in whose absence, private placement of equity is preferred. A public offering is difficult in the absence of a well developed financial system, preference of private placement in such situation would result in transfer of enterprises to certain wealthy racial minority groups, contributing to concentration of wealth with a select few, and thus may defeat the very purpose of privatisation. However, in totally undeveloped or embroyonic capital markets, pri-

vatisation provides an opportunity to create the missing organised financial structure. Studies have shown that Philippines, India, Pakistan and Sri Lanka would need more developed stock markets to facilitate the divestment of public enterprises, and in Bangladesh, sale of enterprises helped in the growth of the stock market (Vuylsteke). However, since then various measures have been taken to broaden captial market and to develop stock exchanges in India.

In totally undeveloped or embroyonic capital markets, privatisation provides an opportunity to create the missing organised financial structures.

Privatisation with the purpose of introducing competition and breaking monopoly, would require guarding against situations resulting in a further concentration of wealth by the sale of shares or assets by the government to certain groups of potential buyers. In Pakistan, privatisation is reported to have resulted in shareholdings by a selected few. Similarly, in U.K. though sale of shares on privatisation had initially led to widespread distribution of shares, there had been, in certain cases, substantial reduction in the number of

Redeployment of the work force after privatisation is an important socio-political factor in developing countries.

small shareholders, leading to skewness in corporate ownership. Further such initial share offers have been priced low, resulting in loss of revenue to the Govt., or wealth transfer, possibly accelerating the inequalities in income and wealth distribution. In cases where sale, on technical grounds, was to business enterprises in the same business lines, like telephone or electricity, diverstiture did not yield maximum revenue to the government. Further, a study of thirteen initial privatisation issues on the international Stock Exchange (London) during 1981 - 87 shows that the magnitude of underpricing of the issues resulted in an average discount of 31 per cent above what could have been expected from the private sector issues. This implies wealth transfer to those who had acquired the shares under the privatisation programme (Kejo Menyah et al, 1990).

Socio-Political Considerations

Political considerations have a predominant impact on the decision of privatisation and also influence the mechanism to be adopted. Redeployment of the work force after privatisation is an important socio-political factor in developing countries; and appropriate remedial measures have to be developed to meet the situation. This is particularly so in economies like Sri Lanka, where one-half of the work force is employed in the public sector which carries prestige and recognition due to the relatively higher wage structure and the hold they have in the political and economic fabric of the country. There may be situations, for example, in Pakistan, where privatisation was to mop up large untapped savings, with a policy decision not to affect any staff reduction, (Jatar, S.C.N., 1990). While in Argentina and Brazil authorities appeared not to compromise on account of employment for purposes of privatisation.

Public enterprises have non-economic objectives also and are often expected to pursue their objectives, ranging from subsidy for consumer goods, assisting certain regions, maintaining employment, and serving as an important instrument to promote income redistribution. However, they have not served to redistribute income, and employment opportunities have been lessened by adoption of capital intensive technology in production. Rather, improvement in wages and employment conditions have created a privileged labour elite, subsidies have often failed to reach the lowest income group and price controls on food stuff have disadvantaged the poor rural producer (Colin Krickpatrick, 1989). Will privatisation result in rectifying such situations?

To quote Ramanadham (1989) on lessons for developing countries, "Public enterprises portfolio is so hetrogeneous, in terms of technical effeciency, profit efficiency, accumulated losses, and employee motivation, that far reaching restructuring would be necessary in most cases, just to improve their performance, prior to a decision on divestiture. The privatisation programme is likely to take a very long time in developing countries; and in several cases the non-ownership options would remain more practicable for quite some time. A developing country does not have to assume that every desirable step in marketisation is only possible through divestiture. Conversely, privatisation will not automatically bring about all desirable market changes, as the

U.K.experience suggests. In short, privatisation is not a panacea for economic ills. It is a family of remedies that can bring great benefits but only when the right remedy is applied in the right circumstances.

Privatisation is not a panacea for economic ills. It is a family of remedies that can bring great benefits but only when the right remedy is applied in the right circumstances.

To sum up, privatisation would necessitate consideration of the following:

- Determining the objective(s) of privatisation which may be: increasing revenue, relief from budgetary financial burden or administrative burden, introducing competition and market forces in operation to improve efficiency etc.
- Guidelines for choosing of public enterprises for privatisation; privatisation may start with profit motive and later on cover others. There should be a time frame for the privatisation.
- Forms or methods of privitisation of enterprises selected: Plan out financial restructuring and rescheduling of debt. Decide:

  whether public or private placement of shares,

  Whether sale of individual assets,

  Whether sales by public auction or otherwise,

  Whether privatisation open to foreign investors; issues like, pricing of issue, timing of issues; quantum, terms and price of referential shares offered to employees, customers and public.
- Terms of privatisation; assured return on investment, quality of service or goods expected and the price for the foods or services to be charged, expected investment in future to ensure continuity of the supply of goods or service, monitoring mechanism to ensure the above aspects.
- State of capital market in the economy and plans for setting up of mutual funds, strengthening of secondary market and stock exchanges, to add liquidity, security issued.
- Expected benefits to consumers on privatisation in terms of quality, availability, price reduction due to efficiency in operations.
- Encouraging investors and customers to invest in shares, schemes of financial assistance in the form of vouchers exchangeable with shares; whether vouchers would be registered and transferable.
- Special terms for employees and customers in the form of loan or vouchers, attractive prices of concessions against future bullings, loyalty bonus, or tax benefits for holding of shares for a certain period. For example, privatisation of enterprises like Telephone Company in Argentina, opened 60 per cent of investment to foreign investors, and the rest was for employees, customers and others. A return of 16 per cent was assured on basic investment of $ 1.9 billion; certain additional investment was exepcted in future years; Reduction in the tariff for the service was expected over the next 10 years.
- Prescribing restrictions on transfer of shares acquired as per special terms above, or on formation of large shareholding or private monopolies.
- Resolving the issue regarding pricing of products or services after privatisation, particularly for products having substantial indirect taxes inbuilt in the price; Whether price after privatisation would be based on demand and supply principles or be influenced by indirect taxes.
- Terms of deployment of employees after privatisation; i.e., whether retrenchment or employment after training.
- Privatisation and National objective: Effect of privatisation on income and wealth distribution in terms of inequality of income and wealth, regional developments and other socio-economic factors.

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Steps to Appointment of a Training Consultant

Check the training consultant's credentials
Clearly specify your needs
Ensure organisational fit
Arrange for written programme details
Make clear evaluation arrangements
Monitor newly appointed consultants
Give clear feedback to the consultant
Be prepared to awkward questions

Source : Productivity Digest, Sept. 1992

Feature

ROI As a Measure of Organizational Performance

M.K. Kolay

The paper examines the traditional concept of return on investments (ROI) and extends its scope to reflect organizational performance more appropriately. Besides profit, it is conceptualized that the returns should include the contributions towards the social goals in the areas of concern of the consumers, the national economy and the society at large. The investments, besides the plant asset base, should include the human resource of the organization and also the suppliers, the customers and the public image asset bases of the organization. The methodology to implement such a concept in practice has been suggested. Such an extended measure in terms of the overall achievement level of corporate objectives in relation to the total asset bases would reflect the total performance of the organization. It is expected that the extended concept of ROI would facilitate development of different asset bases so also the inter-firm comparison.

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With profitability as the overriding goal of organizations for success and growth, return on investment (ROI) has been the criteria in practice to reflect the organizational performance. The same concept of ROI has been used as the basis for defining various surrogate productivity measures of an organization (Risk, 1965; Gold, 1974; Eilon, Gold & Soesan, 1976; Miller, 1987). Generation of surplus is no doubt important but should it be considered as the only goal of an organization? An organization being a part of the social system is expected to fulfil certain social responsibilities. A survey of researches on such corporate social responsibility (Krishnamacharyulu & Murthy, 1986) reflects that most corporate managers agree on the desirability of the fulfillment of social responsibility. However, in practice, it is neither considered as an organizational goal nor as a criteria for decision making. Organizations might fulfil certain social responsibilities which are incidental to the attainment of corporate profitability objectives or perhaps due to restrictions imposed by the local government.

Generation of surplus is no doubt important but should it be considered as the only goal of an organization?

On the investment side, the capital employed in the business in the form of the plant and the infrastructural facilities (herein termed as the plant) is usually considered. Sometimes, working capital deployed is also considered as another component of total capital employed. However, working capital being short term in nature with its requirements depending mostly on the day-to-day operational decisions of the management,

the plant asset base may be the relevant investment of the organization to which the returns after meeting the cost of working capital might relate. However, the plant asset base is not the only investment of an organization for assessing the ROI. In fact, the human resource is the most important asset base of an organization. Without such a resource, all other physical and financial resources are useless. Besides the human resource, the suppliers and the customers are important to an organization to ensure smooth availability of required inputs at the input front and the despatch of produced goods and services at the output front. An organization in course of its business builds up relationships with the bankers, the financial institutions, the local government and thus with the society in general, developing its image as its another important asset base.

The question arises therefore whether the returns should reflect the profit alone, or should include the contributions towards the social goals along with the profits and the investments should include the plant base alone or the human resource, suppliers, customers, and the public image along with the plant base. This issue has been examined in this paper.

Profit Goal versus Profit & Social Goals

Profit maximization may be a universal goal for being in business and an important barometer for measuring the organizational effectiveness to maintain stable dividend policy and to plough back adequate surplus into the organization to sustain the rate of growth from the shareholders, point of view. However, production of more volume of goods and services to meet the demand of the ever increasing masses, improvement in quality of the products to gradually raise the standards of living and control of cost to maintain the price level within the purchasing power of the common man are some of the important areas of concern of the consumers. Development of indigenous technology to become self-reliant, development of the ancillaries and the small scale sector to facilitate the rate of growth of the industrial sector, cutting down imports and promoting exports to improve the adverse balance of payment position of the country and the conservation of non-renewable natural and scarce resources of the country are some of the important areas of concern of the national economy. Generation of more employment opportunities, protection of the environment and extending opportunities to the backward classes to remove the social disparity are some of the areas where the society expects an organization to play a part.

Profit maximization may be a universal goal and an important barometer for measuring the organizational effectiveness.

The areas of concern of the consumers might be the areas of concern of the organizations too. Customer satisfaction leads to improvement of the profitability of the organization. So also may be the case pertaining to the area of concern of the national economy. Organizations should reinforce their research and development base to improve the quality of their products and boost exports use indigenous inputs and develop their own technology to reduce cost in a bid to improve profitability. Productivity improvement of the input factors like that of non-renewable natural and scarce resources might be the way to reach the profit goal itself. Areas of concern of the society like the generation of more employment opportunities or the protection of the environment etc. are not areas of concern of the organization directly from the profitability improvement point of view. In fact, the organization might be interested to lay off its extra labour force. Thus, the efforts towards fulfilment of social goals in the areas of concern of the consumers, the national economy and the society at large may directly or indirectly facilitate to achieve the profit goal, i.e. the area of concern of the shareholders.

However, caring for the areas of concern of other agencies towards the achievement of social goals with consequent favorable impact on profitability may not be the optimal path to improve the profitability of the organization. Infact, cutting down production, compromise in quality, going in for imported technology or "no-new recruits" policy might be the decisions of the management to improve profitability. Thus, given the choice, the management would not always adopt the ways and means that would be conducive to the areas of concern of other agencies along with that of the shareholders in a bid to achieve the profit targets. The only recourse is to consider other areas of concern as another set of goals to be achieved by an organization and used as criteria for decision making by the management just like the profit goal. This would enable the organization not only to play its role toward the social goals but also to optimize the overall achievement level of corporate objectives, both profitability and social with different priorities attached to different objectives during different

periods of time. The profit goal alone may reflect a part of the picture rather than the total contributions that the organizations might be making to satisfy the interests of the different agencies and the society in general. Comparative profit figures and returns on investment of two organizations belonging to two different sectors are not comparable. Profit may be the most important goal for the private sector but besides profitability, social goals are important for a public sector organization. An R&D organization may not be making any profit but it may be the nerve centre of technological developments of the country.

Thus, the choice goes for "not profit alone" but for the profit and social goals and the returns of an organization may have to be reflected by the extent of achievement level of corporate objectives pertaining to the areas of concern of not only the shareholders, but the consumers, the national economy and the society at large.

Plant Asset Base versus Total Asset Bases

To achieve the aforesaid twin objectives, the plant facilities are no doubt important to convert the inputs into outputs. However, plant is not the only asset base used by an organization. Infact the human resource, as every corporate manager acknowledges, is the most important asset base of an organization. Future benefit potentials elevate the personnel to an asset and efforts are still on to recognize the human resource as asset in the balance sheet (Kolay, 1987).

The human resource is the most important asset base of an organization.

Besides the human resource and the plant, the two internal asset bases, suitable strategies are adopted by the organization in the course of its business to strengthen the relationships with the existing suppliers and to develop potential suppliers to ensure smooth availability of the required inputs. Investments in sources development and the periodic imputed cost associated with different strategies adopted to nurture the existing suppliers, with long term agreements, represent future benefit potentials and may be considered as an external asset base of the organization. Like the suppliers at the input front, in the course of marketing the outputs, the organization has to develop new markets, to serve new customers and to reinforce the relationships with them. Cost of promotional efforts to launch new products or to boost sales of the existing product lines, the imputed cost of liberalizing the discount/credit terms, and the investments in the distribution system to serve the customers better represent future benefit potentials with consequent development of the customer base, as another external asset base of an organization.

Besides the development of the suppliers and the customers, the organization adopts suitable strategies to develop and strengthen the relationships with its bankers and the local government. In addition, it invests in anti-pollution measures, community development and social welfare programmes etc. for the society in general. Such efforts with their associated cost lead to the development of the public image as another external asset base of the organization.

Thus the long term investment of an organization is not in the form of the plant alone but includes the most important internal asset base—the human resource and three other external asset bases—the suppliers, the customers and the public image. Again when the expense approach is followed with respect to such assets as in the traditional accounting practices, the returns are understated at times of asset building while spurious returns are reflected when the asset bases are depleted. To reflect organizational performance more appropriately, the concept of return on investments may therefore need to be broadened to relate the extent of fulfilment of corporate profit and social goals rather than profit goal alone with the total investments in the five asset bases rather than only in the plant.

Methodology for implementation

To implement the proposed concept, the first step is to assess the overall achievement level of corporate objectives during a certain period of time. Following the methodology as proposed by Kolay (1990), the relative overall achievement level is assessed as follows:

1. Assessment of the achievement level relevant to a specific area fulfilling the interest of a specific interest group. Such an assessment may be made periodically on a relative basis, (relative to the chosen base period) based on the relevant factors (as reflected in Figure 1).
2. Assessment of the relative achievement level pertaining to each interest group i.e., the shareholders, the consumer, the national economy

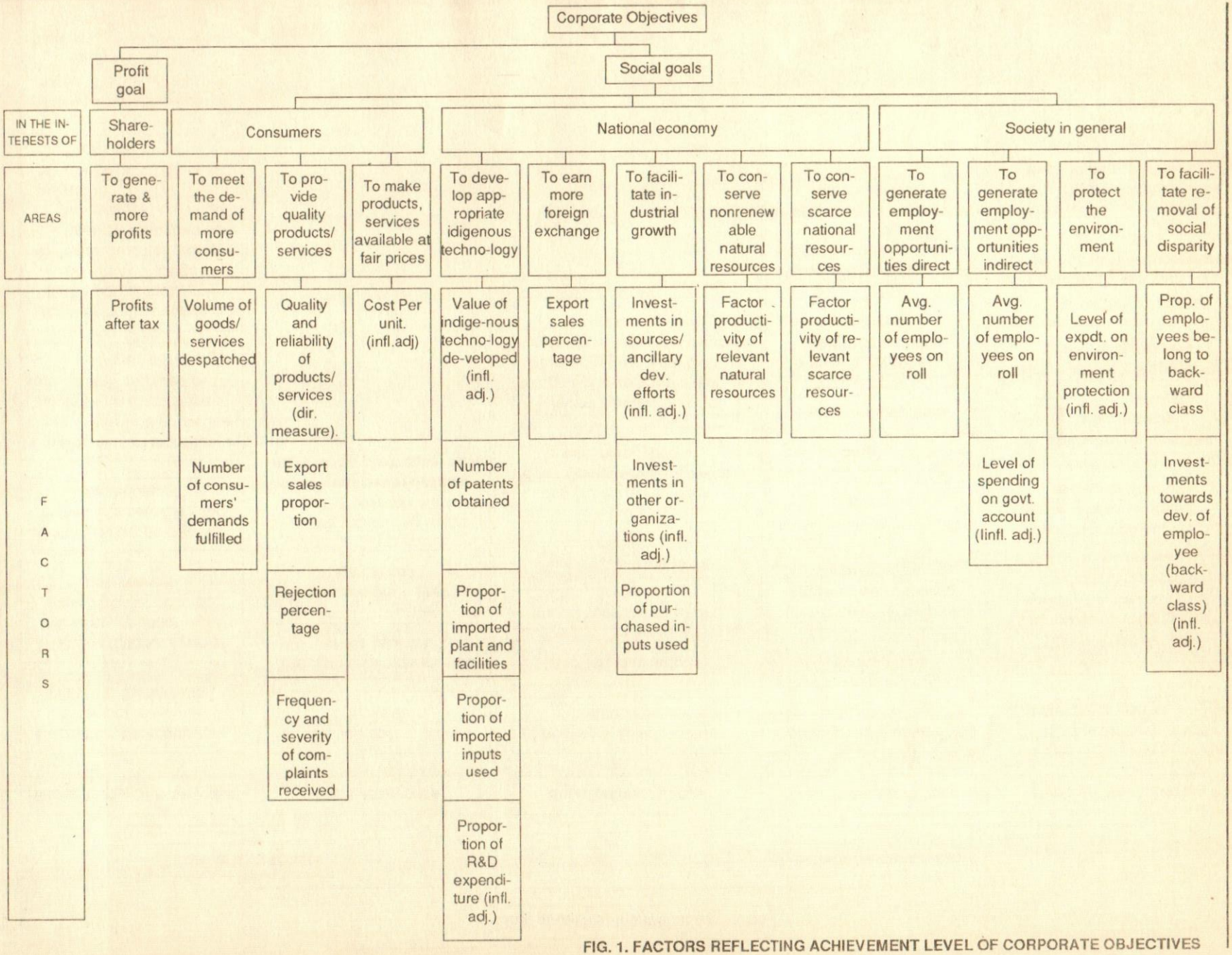

FIG. 1. FACTORS REFLECTING ACHIEVEMENT LEVEL OF CORPORATE OBJECTIVES

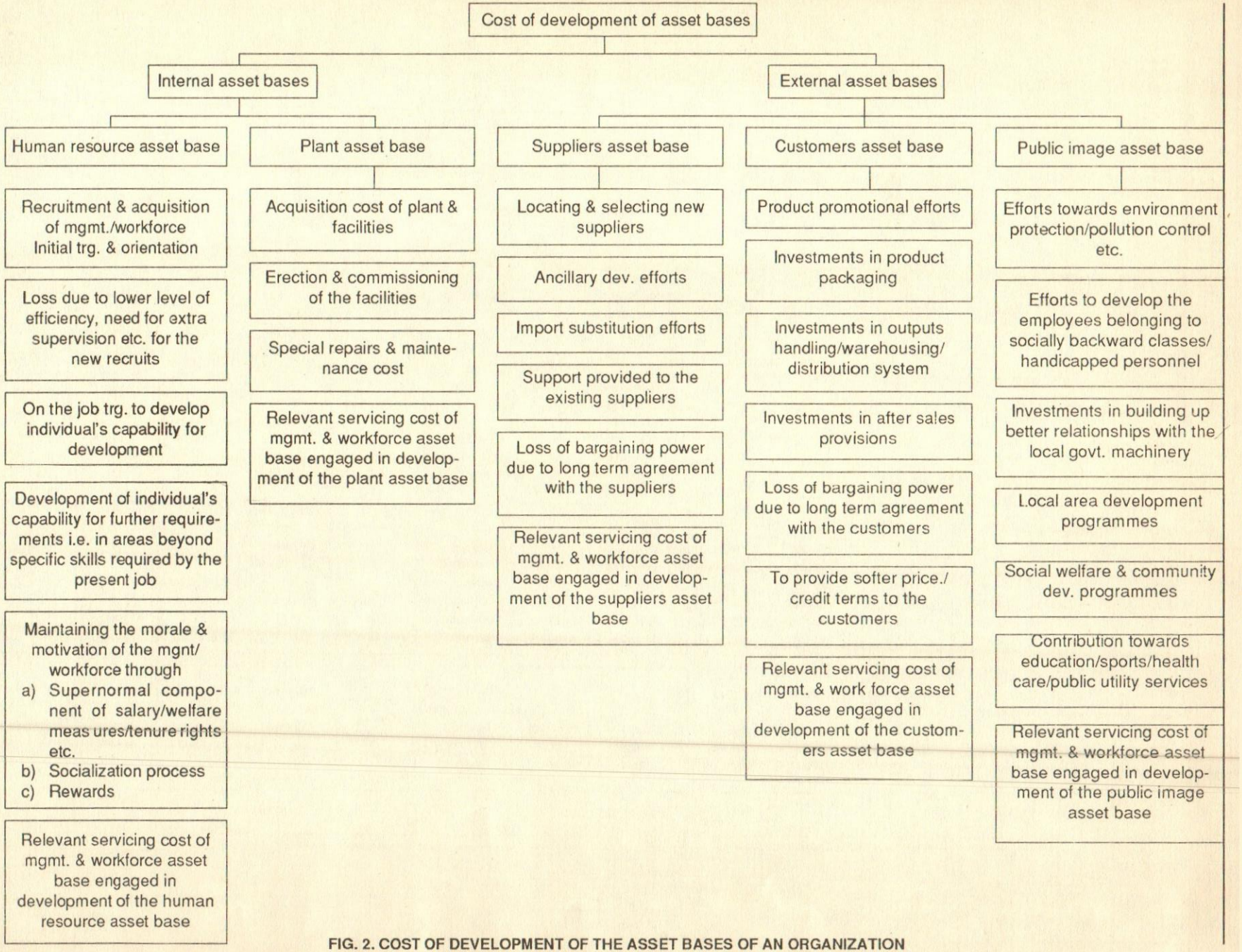

FIG. 2. COST OF DEVELOPMENT OF THE ASSET BASES OF AN ORGANIZATION

The long term investment of an organization is not in the form of the plant alone but includes the most important internal asset base—the human resource and three other external asset bases—the suppliers, the customers and the public image.

and the society based on the performance criterion, their respective area(s) as assessed in (1) above

3. Assessment of the relative achievement level of the organization towards social goals by aggregating the performance of the three interest groups, i.e., the consumers, the national economy and the society.

4. Assessment of the relative overall achievement level of corporate objectives based on the performance towards profit and social goals. Suitable weightages have to be assigned at each of the aforesaid stages to assess the relative overall achievement level. The relative achievement level of corporate objectives thus arrived at have to be judged in relation to the total investments in the different asset bases of the organization. Figure 1 illustrates the factors reflecting the achievement level of corporate objectives.

Future benefit potentials have been the essence to consider such cost elements as asset rather than expense. Normal cost of servicing of the asset bases like the power cost incurred on running a machine, may not constitute an asset; however, the supernormal component of salary, benefits etc. may be contributing significantly towards maintaining the morale and motivation of the employees and thus constituting as an asset rather than expense. Moreover, the cost of servicing the human resource, engaged in the development and maintenance of the different assets, has been duly considered to form part of the development cost of the asset bases.

From the periodic investments towards the different asset bases, the relative cumulative investments (relative to the base period) i.e., the relative gross block of the total asset bases of the organization may be determined. The relative overall achievement level of corporate objectives may be judged in relation to such a value (gross block) of the total asset bases to reflect the organizational performance.

The different cost elements that constitute the internal and external asset bases of an organization are presented in Figure 2.

Conclusions

The criteria of the return of investments as it goes in the traditional practices do not adequately reflect the organizational performance. The returns should not reflect the profit alone but should include the contribution towards different social goals. Investments on the other hand, may not only include the plant base but also the suppliers, the customers, the public image and above all the human resource of the organization. Extending the scope of the term returns as well as the investments, such a redefined measure would reflect the total picture of the performance of an organization.

With the incorporation of the contribution towards social goals, the profit centre managers may not be tempted to improve the profitability at the cost of social goals. Recognition of the future benefit potentials of the investments in the human resources, the suppliers, the customers and the public image, besides the plant would encourage the managers to develop such asset bases. With the emphasis on social goals being different in two organizations, so also with the relative investments in the different asset bases, such a measure would greatly facilitate the inter-firm comparison. The concept however, does not recognize the effect of mutual interrelationships amongst the different asset bases. The investments have been considered to constitute the asset bases, however, besides investments the asset bases might be developed as a result of achievement level of corporate objectives over the years.

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Industrial Sickness in India

S.S. Khanka

This paper examines the growing incidence of industrial sickness, its cause and the limited success of revival efforts. It urges the introduction of appropriate systems for early detection at the incipient stage. The specific suggestions put forward are that a large number of sick units be permitted to close and liquidate, a few sick and weak units be picked up for revival and rehabilitation purposes. The kingpin role of human factor in management, labour, trade unions, financial institutions and government in dealing with the problems of industrial sickness has been emphasised.

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Of late, industrial sickness in India has been on the increase and has assumed alarming proportions emerging as a source of great concern for the country. The number of sick units, has increased by nine times to 221,097 in the end of March, 1990 from 24,550 at the end of December 1980 and outstanding bank credit against them by more than three-times over the same period. At the end of March 1990, an outstanding credit of Rs. 9,353 crore constituting about 9.2 per cent of the total bank advances and 17.4 per cent of the outstanding bank credit to industries was locked up in more than 2.2. lakh sick industrial units on the roll of commercial banks. The progressive increase of industrial sickness has affected all those related to sick units—the government, financial institutions, banks, entrepreneurs, creditors, etc. The major repercussions of industrial sickness have been the locking up of the country's limited financial resources, wastage of capital assets, loss of production and increase in unemployment. Therefore, a coherent framework consisting of causes and symptoms of industrial sickness and also a system predicting potential industrial sickness are needed to minimise, if not eliminate, the growing industrial sickness in the country.

The major repercussions of industrial sickness have been the locking up of country's limited financial resources, wastage of capital assets, loss of production and increase in unemployment.

Magnitude of Industrial Sickness

The steady growth in the incidence of industrial sickness during the decade 1980 - 90 is brought out in table 1. The incidence of growing industrial sickness marks all industries—small and large and traditional

Table 1 : Growing Industrial Sickness During 1980-90

Year	No. of Sick Units				Outstanding Bank Credit (Rs. Crores)			
	Large Units	Medium Units	Small Units	Total	Large Units	Medium Units	Small Units	Total
December 1980	409	992	23,149	24,550	1,324.47	178,42	305.77	1,808.66
December 1981	422	994	25,342	26,758	1,478.47	187.63	359.07	2,025.54
December 1982	444	1,178	58,551	60,173	1,790.60	225.76	568.97	2.585.33
December 1983	491	1,256	78,363	80,110	2,014.33	357.97	728.99	3,101.29
December 1984	545	1,287	91,450	93,282	2,330.12	428.58	879.69	3,638.39
December 1985	637	1,186	1,17,789	1,19,606	2,989.24	220 02	1,070.67	4,270.93
December 1986	714	1,250	1,45,776	1,47,740	3,287.02	281.37	1,306.10	4,874.49
December 1987	Non-SSI	1,119	2,04,259	2,05,378	Non-SSI	2,801.79	1,797.31	4,599.10
December 1988	-do-	1,241	2,40,573	2,41,814	-do-	3,887.30	2,141,00	6,028.30
March 1990	-do-	1,455	2,18,828	2,20,283	-do-	4,538.82	2,426.94	6,965.76

Source : Reserve Bank of India, *Report on Currency and Finance* of respective years.

and modern. The incidence of industrial sickness has increased exponentially by about nine times during 1980 -90. As on 31st December, 1980, there were 24,550 sick units of all types in the country with a total outstanding bank credit of Rs. 1,809 crore. By March, 1990, the number of sick units rose to 220,283 with outstanding bank credit of Rs. 6,966 crore. Of these 2,20,283 sick units, 1,455 (0.66 per cent of the total sick units) were non-SSI sick units with 65 per cent of the total outstanding bank credit (Rs. 4,539 crore). Thus, only 35 per cent of the total outstanding bank credit was locked up in 99.34 per cent small scale sick units of the total sick units. Though small scale sick units exceeded many times the number of non-SSI sick units, the later had locked up much more bank money. Another feature is that while the outstanding bank credit per non-SSI unit has been steadily increasing from Rs. 1.07 crore to Rs. 3.12 crore during 1980-90, that of small scale unit, on the contrary, has been decreasing from Rs. 1,27 lakh to Rs. 1.11 lakh during the same period.

Distribution

There is ample evidence to show that industrial sickness is concentrated in some industries, regions and sectors in India. Industry-wise distribution of sick industrial units is provided in table 2.

Sickness is an industry phenomenon. Among the non-SSI units, industry-wise classification indicates that sickness was more pronounced in the case of engineering and electricals group with 299 sick units with outstanding bank credit of Rs. 973.93 crore followed by textiles (276 units), chemical (140 units), paper (113

Table 2 : Industry-Wise Distribution of Sick Industrial Units (At the end of September. 1989)

Industry	Non-SSI Sick Units		SSI Sick Units		Total Sick Units	
	Number	Outstanding Bank Credit (Rs. in crores)	Number	Outstanding Bank Credit (Rs. in Crores)	Number	Outstanding Bank Credit (Rs. in crores)
Engineering & Electricals	299	973.93	23,597	514.10	23,896	1,488.03
Iron and Steel	91	241.06	2,356	110.49	2,447	351.55
Textiles	276	1,274.46	15,308	151.12	15,584	1,425.58
Chemicals	140	215.98	6,751	206.45	6,891	422.43
Sugar	20	58.69	371	14.27	391	72.96
Jute	35	156.95	203	12.75	238	169.70
Rubber	15	61.08	953	36.50	968	97.58
Cement	22	138.14	405	13.61	427	151.75
Paper	113	244.13	1,881	46.02	1,994	290.15
Other Industries	408	893.41	1,34,616	1,138.00	1,35.024	2,031.41
Total	1,419	4,257.83	1,86,441	2,243.31	1,87,860	6,501.14

Source: Reserve Bank of India : *Report on Currency and Finance. Volume 1. Economic Review*, 1990-91.

units), iron and steel (91 units) with outstanding bank credit of Rs. 1,274.46 crore, Rs. 215.98 crore, Rs. 244.13 crore and Rs. 241.06 crore, respectively as at the end of September, 1989. These five industry-groups accounted for more than three-fifths (62.8 per cent) of the total number of non - SSI sick units and two-thirds (66.9 per cent) of the total outstanding bank credit to such units as at the end of September 1989. Similar rampant industrial sickness is observed in the case of SSI units also where the five industry-groups accounted for 27 and 46 per cent of total SSI sick units and outstanding bank credit respectively.

As regards the state-wise concentration of industrial sickness, in the case of non-SSI sick units, the incidence was the highest in Maharashtra followed by West Bengal, Gujarat, Tamil Nadu, Andhra Pradesh, Uttar Pradesh and Karnataka. For good measure, these seven industrially advanced states together accounted for 75 per cent of the total number of non-SSI sick units and 80 per cent of the total outstanding bank credit as at the end of September 1989 (See table 3). A similar pattern of statewise concentration of sickness is noticed in the case of SSI sick units also.

To a large extent, the state-wise pattern of industrial sickness corresponds with the historical pattern of industrialisation in India. The seven states mentioned are also characterised by the presence of industrial units operating the textiles, engineering goods and jute which happen to be the industries more afflicted with industrial sickness (table 2). To quote, of the total number of 321 non-SSI sick units located in Maharashtra as at the end of September 1989, 84 were operating in engineering and 75 in textiles industries. Similarly, out of 182 non-SSI sick units in West Bengal, the number of sick units operating in engineering and jute industries were 32 and 31 respectively (RBI. 1990-91 : 70-71). There is more concentration of industries in these few states than can be sustained by their infrastructure network like transport, communication, power etc. There is cut-throat competition in these states for procuring inputs and market. The result is that the inefficient units fail to compete with the efficient ones as the cost of the former is grossly wiped out by that of the latter. Thus the number of sick units in these states is bound to be large (Mehta, 1988).

There is more concentration of industries in a few states than can be sustained by their infrastructure network like transport, communication and power.

Table 3 : State-wise Incidence of Industrial Sickness (At the end of September. 1989)

Industry	Non-SSI Sick Units		SSI Sick Units		Total Sick Units	
	Number	Outstanding Bank Credit (Rs. in crores)	Number	Outstanding Bank Credit (Rs. in Crores)	Number	Outstanding Bank Credit (Rs. in crores)
Andhra Pradesh	121	334.69	21,461	172.69	21,582	507.38
Gujarat	154	512.32	6,302	177.89	6,546	690.21
Karnataka	77	225.62	8,318	121.98	8,395	347.60
Kerala	31	139.24	17,021	114.12	17,052	253.36
Madhya Pradesh	47	129.92	14,675	78.42	14,722	208.34
Maharashtra	321	1,265.01	14,497	450.03	14,818	1,715.04
Tamil Nadu	130	267.22	10,105	213.92	10,235	481.14
Uttar Pradesh	82	192.82	24,401	193.09	24,483	385.91
West Bengal	182	611.06	25,648	221.32	25,830	832.38
Bihar	42	98.97	5,250	65.13	5,292	164.10
Haryana	46	85.79	2,179	55.92	2,225	141.71
Rajasthan	44	109.29	11,925	59.97	11,969	169.26
Other states & Union Territories	142	285.88	24,659	318.83	24,801	604.71
Total	1,419	4,257.83	1,86,441	2,243.31	1,87,860	6,501.14

Source : Reserve Bank of India, Economic Review. 1990-91.

Table 4 : Viability Status Of Sick/Weak Units (At The End of March 1990)

Industry	Non-SSI Sick Units		SSI Sick Units		Total Sick Units	
	Number	Outstanding Bank Credit (Rs. in crores)	Number	Outstanding Bank Credit (Rs. in Crores)	Number	Outstanding Bank Credit (Rs. in crores)
Andhra Pradesh	121	334.69	21,461	172.69	21,582	507.38
Viable units	16,451	590.50	841	3,026.91	17,292	3,617.41
	(7.5)	(24.3)	(37.1)	(43.7)	(7.8)	(38.7)
Non-Viable units	2,00.092	1,741.07	966	2,101.67	2,01,058	3,842.74
	(91.4)	(71.8)	(42.6)	(30.3)	(90.9)	(41.1)
Viability not decided	2,285	95.37	462	1,797.01	2,747	1,892.38
	(1.1)	(3.9)	(20,3)	(26.0)	(1.3)	(20.2)
Total	2,18,838	2,426.94	2,269	6,925.59	2,21,097	9,352.53
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
(a) Units under nursing programme	12,160	470.92	491	1,998.17	12,651	2,469.09
(b) As percentage of Viable units	73.9	79.7	58.4	66.0	73.2	68.3

N.B. (i) The figure is exclusive of 125,571 sick SSI units which are not traceable.
(ii) Figures in brackets show percentage to total.

Source: Ministry of Finance Economic Survey, 1991-92 .

Viability Status of Sick Units

A sick industrial unit is said to be viable if in the opinion of the banks assessing its viability, it would be in a position, after implementing a package of concessions spread over a period not exceeding seven years from the commencement of the package, to continue to service its repayment obligations as agreed upon, including those formulating part of the package without the help of any further concessions after the aforesaid period (Ministry of Finance, 1986). Viewed from this aspect, one way of gauging the growing severity of industrial sickness in India is that in every 10 sick units, 9 are reported as non-viable (See table 4). Of the total outstanding bank credit, more than 40 per cent is locked up in non viable units. In the case of non-SSI sick units, nearly three-fourths of outstanding bank credit is locked up in non-viable sick units. Nearly three-fourth of the sick units are reported to be under nursing programmes. However, information is not available as to the follow-up of these programmes. Thus, the overall scenario of industrial sickness in India forbodes a dire future and has become a source of great concern for the country.

Causes of Industrial Sickness

Internal Causes: These arise due to some deficiencies in various functional areas like finance, production, marketing and personnel which are controllable through positive attitude and timely action. Studies have brought out the fact that the health of large industrial units often corrodes due to internal causes like mismanagement. The study conducted by the Reserve Bank of India underlined the fact that out of 378 large sick units in 1979, 52 per cent fell sick due to mismanagement problem and 14 per cent due to initial faulty planning which is also a management responsibility. Individual researches (Sandesara 1987; Srivastava and Yadav 1986) also confirm that the predominant causes of corporate failure are management deficiency, mismanagement and management dissensions.

External Causes: External causes are the outcome of changes in the structural and environmental factors like infrastructural bottlenecks, economic cycles, industrial and fiscal policies of the Government which are beyond the control of the unit's management. In most of the cases, small scale units fall prey to sickness due to the aforesaid external factors. The Development Commissioner (1985) conducted a diagnostic study of small scale units in India which concluded that non-availability and price hike of raw materials, shortage of working capital and marketing problems are the major causes of sickness in small scale units. The studies made by Reddy and Appa Rao (1988) in Andhra Pradesh and Khanka (1990) in Uttar Pradesh also confirm that external factors are the major causes of failure in the small scale sector.

Non-availability and, price hike of raw materials, shortage of working capital and marketing problems are the major causes of sickness in small scale units.

Solutions

(i) Industrial sickness is not an overnight occurrence but is a gradual process over 5 to 7 years corroding the health of a unit beyond cure. Therefore, the identification and detection of sickness at the incipient stage is the first and foremost measure to reduce industrial sickness. For identifying sickness at an early stage, appropriate yardsticks need to be evolved and developed.

However the ongoing criterion of cash loss underlying all definitions of sickness cannot be regarded as sufficient advance signal of the ultimate consequence of extreme sickness. For instance, the wiping out of the entire net worth of a unit accompanied by atleast two consecutive years of cash loss clearly signals extreme stage of sickness which would, in fact, take the enterprise to the verge of closure. Likewise are severe cash losses with persistent defaults in institutional debt studies. Gupta (1983) investigates the typical path to the present cash loss situation of sick units as represented by the annual average profitability index of sick units. He indicated that in the early stages (i.e upto 6 years preceding the cash loss period), the profitability index showed a marginal decline, followed by sustained decline during the period of 3 years preceding the cash loss. Therefore, it is necessary to identify the symptoms which signal the setting in of the process of sickness. For instance, in the stock exchanges a clear signal of the sickness of the unit comes at a much earlier stage when the dividends are skipped and its impact is reflected in terms of a sharp decline in the share price. At present, the information available on sick units is highly limited, like the magnitude of sickness by size, by broad industry group, by regions and by outstanding bank credit. But its aggregate nature hides much more than what it reveals. For instance, we have no idea about the age, financial structure, size, distribution, ownership pattern, product mix, cost structure, organisational make-up, performance indicators etc., of the sick units. But, knowledge of these is crucial for revival/rehabilitation strategies.

(ii) In view of the limited resources at the disposal, a large number of sick units may be permitted to close/liquidate; a fewer number of sick units may be piked up for revival/rehabilitation and a large number of weak units may be combined together to prevent sickness. However, merger of a large number of sick units would be a welcome proposition only when complete social security for labourers displaced due to unit closure is prevalent in the society.

(iii) At present, the attitudes of the three sets of a unit—management, financial institution and labour do not converge as they view the problem of industrial sickness quite differently. Management seeks freedom to close the unit if it feels it is no more viable. Financial institutions think that whatever can be salvaged should be salvaged. Labour view is that in the event of closure of the unit, they will lose job, provident fund and other benefits; therefore, the units should continue production. Thus, all the three drag in different directions. But if these diverse viewpoints could be integrated, the unit can be salvaged in the best interest of all three.

(iv) The various revival and rehabilitation programmes adopted by SICA 1985 and BIFR mainly relate to financial assistance to sick units. However, the pathology of industrial sickness suggests that most cases are due to human factors like poor management skill, deliberate mismanagement, low labour productivity, etc. Unfortunately, the problem of human resource development is not receiving the necessary emphasis. It is essential to improve the quality and sensitivity of the human factor at all stages i.e., management, labour, trade unions, financial institutions and government. This will definitely arrest the growing industrial sickness in the country and usher industrial prosperity.

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Commercial Crops in Punjab : Productivity Growth & Factor Contribution

Inder Sain & Maan Singh Toor

The present study is an attempt to examine the productivity growth and factor contribution relating to the traditional commercial crops in Punjab. The period covered in the study relates to 1975-76 through 1989-90. The analysis clearly created three crop belts based on the dominance of commercial crop specialisation. These are the sugarcane, cotton and miscellaneous crop belts. Productivity growth is the lowest in the cotton belt while the sugarcane belt has the highest productivity. Even the contribution of prices in case of cotton belt is negative whereas it is positive for sugarcane belt. The analysis provides us guidelines for establishing agro-industries in the particular belt ensuring feedback rather than scattering them over the whole state. Further, a need for strengthening the research base for commercial crops and a remunerative price policy is felt as this would prove helpful in diversifying the State agriculture.

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Lately efforts are being directed towards improving the productivity of commercial crops like cotton, sugarcane, oilseeds etc. The proliferation of agro industries in Punjab is another aspect that necessitates improvement in the productivity of these crops. In this paper, an attempt has been made to examine:

- The growth pattern of commercial crops in Punjab;
- The value productivity of major commercial crops in different districts of the State;
- Contributions of various price and non price factors towards growth;
- To spell out the policy implications of the analysis.

Material & Methods

The data used in this study was taken from various issues of the Statistical Abstracts, Punjab. The period covered in the analysis was from 1975-76 to 1989-90. Crop value productivity was calculated by giving wieghtage to the area under traditional commercial crops in the respective years. In case of real value productivity for the terminal year, the value productivity at current prices was duly deflated by constructing the price index for each district separately which gives us the real growth in the value productivity of traditional commercial crops over the study period.

In order to quantify the contribution made by different factors towards growth, seven factor model used by Vaidyenathan was applied. This model is superior to the model used by Minhas as it is capable of identifying the role of price and non price factors while the Minhas model provides help only in quantifying the contribution of non-price factors. The details of the model used are as follows:

$$\Delta Y = Y_1 - Y_0 = \sum a_{c_0} Y_{c_0} \Delta P + \sum a_{c_0} P_{c_0} \Delta Y + \sum Y_{c_0} P_{c_0} \Delta a + \sum a_{c_0} \Delta P \Delta Y + \sum P_{c_0} \Delta a \Delta Y + \sum Y_{c_0} \Delta a \Delta P + \sum \Delta a \Delta Y \Delta P$$

This decomposition of productivity growth gives us price effect, yield effect and cropping pattern effect and interaction effects such as price × yield, cropping pattern × yield, cropping pattern X price and cropping pattern × Yield × price respectively. The symbols 0 and I refer to the base and terminal year while △stands for change in the equation.

Changing scenario in acreage

As seen from table 1, of the total area under traditional commercial crops in the base year (i.e. 1975-76), 20.05 per cent was under desi cotton, 36.89 per cent under American cotton which was followed by groundnut, rapeseed and mustard and sugarcane with 17.07, 12.40 and 11.59 per cent in the state respectively. In the case of the terminal year (i.e. 1989-90), the acreage pattern under commercial crops entirely changed with dominating position of American cotton for which area increased to 70.94 per cent while all the other commercial crops recorded a decline. Thus, American cotton established itself as the major commercial crop over time at the state level. The disaggregated analysis at the district level reflected three crop belts in the State. As seen from the table, Gurdaspur, Jalandhar, Hoshiarpur. Ropar and Patiala districts formed one belt where sugarcane crop dominated during the study period. Ferozepur, Faridkot, Bathinda and Sangrur formed the second belt where American cotton dominated. Kapurthala, Amritsar and Ludhiana districts entered the third belt where more than one crop such as groundnut and sugarcane in the case of Kapurthala, rapeseed and mustard and sugarcane in the case of Amritsar and cotton and sugarcane in the case of Ludhiana dominated the cropping schedule.

In case of crop belt I, the major shift of area from traditional commercial crops favoured sugarcane where more than 3/4 of the total area under commercial crops was during the terminal year. The second important crop in the case of Jalandhar, Ropar and Patiala falling in this belt was rapeseed and mustard where a substantial increase in area was recorded over time. In the case of crop belt II, the major shift was favourable to American cotton where more than 70 per cent of the total area under major commercial crops was recorded for 1989-90. This favourable shift to American cotton in Ferozepur, Bathinda, Faridkot and Sangrur was at the cost of desi cotton, groundnut and sugarcane where a sharp decline in these crops corresponding to the above period was

Table 1 : Changed Scenario of Acreage under Major Traditional Commercial Crops in Different Districts of the Punjab State for 1975-76 through 1989-90

Crop Belts / Districts	Cotton Desi		Cotton American		Groundnut		Rape & Mustard		Sugarcane	
	1975-76	1989-90	1975-76	1989-90	1975-76	1989-90	1975-76	1989-90	1975-76	1989-90
I. *Sugarcane Belt*										
Gurdaspur	9.96	0.45	-	-	-	-	14.34	13.45	75.70	86.10
Jalandhar	16.51	2.76	0.96	3.10	34.93	4.83	6.94	11.03	40.67	78.28
Hoshiarpur	15.91	2.28	-	-	11.36	15.43	15.91	9.14	56.82	73.14
Ropar	6.83	2.86	-	-	44.18	2.14	4.82	11.43	44.18	83.57
Patiala	23.18	13.33	11.31	16.36	40.50	4.85	6.84	17.58	18.16	47.88
II. *Cotton Belt*										
Ferozepur	12.33	7.12	73.44	77.45	0.25	0.13	10.71	12.29	3.37	3.05
Faridkot	13.86	4.84	73.29	89.85	1.23	0.17	10.49	4.59	1.12	0.55
Bathinda	22.69	4.94	55.63	85.71	2.08	0.13	17.99	8.69	1.60	0.53
Sangrur	47.03	16.91	7.85	69.61	27.92	4.67	9.01	3.42	8.19	5.39
III. *Misc. Crop Belt*										
Kapurthala	8. 70	1.28	-	-	73.91	46.15	4.97	6.40	12.40	46.15
Amritsar	19.66	4.12	23.35	4.94	-	-	40.09	72.02	16.90	18.93
Ludhiana	23.68	25.45	6.72	22.27	57.82	10.00	1.87	9.09	9.91	33.18
State as a whole	22.05	6.79	36.89	70.94	17.07	1.70	12.40	9.76	11.59	10.82

recorded. The area under rapeseed and mustard also declined in all the above districts with an exception in Ferozepur district where a small increase in area under this crop was observed. In crop belt III, the acreage response was favourable to sugarcane in Kapurthala and Ludhiana where 46.15 and 33.18 per cent of total area under the commercial crops was observed during 1989-90 as compared to 12.42 and 9.91 per cent in 1975-76. Another important commercial crop for which acreage increase was recorded was cotton desi in Ludhiana and groundnut in Kapurthala. Amritsar district of this belt witnessed a favourable shift to rapeseed and mustard where 72.02 per cent of the total area under traditional, commerical crops in this district was recorded.

Value Productivity & Growth

Table 2 relates to the value productivity both at current as well as constant prices over 1975-76 through 1989-90. At the state level, the value productivity at current prices increased to Rs. 12,441 in 1989-90 as compared to Rs. 2,770 in 1975-76. In terms of constant prices with 1975-76 as the base period, it increased to Rs. 4,013, revealing an increase of 45 per cent only. The disaggregated analysis in the respective belts on the basis of dominance of commercial crops revealed that value productivity of commercial crops was highest in crop belt I which comprised those districts having dominance of sugarcane crop. This was quite obvious as sugarcane is an annual crop. The magnitude of value productivity in this belt increased from Rs. 4096 in 1975-76 to Rs. 21070 at current prices in 1989-90. The value productivity at constant prices was Rs. 6581 indicating an increase of 60.67 per cent over 1975-76. In case of crop belt II comprising the districts dominating in American cotton, the level of value productivity increased from Rs. 2536 to Rs. 3762 at constant prices. This showed an increment of 48 per cent over the base period. With respect to crop belt III consisting of districts dominating in more than one commercial crop, the value productivity observed was Rs. 2666 in 1975-76 as compared to Rs. 4185 at real prices in 1989-90. Thus, an increase of 54 per cent over the base period in belt III was recorded. On the whole, the area dominating in cotton crop falliing in belt II had the lowest value productivity of commercial crop in comparison to the areas falling in crop belts I and III in the State.

Decomposition analysis

In order to work out the contribution of different factors towards growth in productivity, the decomposition analysis accounting for the role of price and non-price factors has been done and the results thus obtained are shown in table 3. It emerged that the contribu-

Table 2 : Value Productivity and Growth in Major Traditional Commercial Crops in Different Districts of Punjab Over Time at Current as well as real Proces

	Crop Belts Districts	1975-76	1989-90		Per cent change in real value productivity over 1975-76)
			(At current price)	(At real price with base 1975-76)	
I.	*Sugarcane Belt*				
	Gurdaspur	4742.37	22713.64	6879.38	47.17
	Jalandhar	4470.43	22935.44	7204.33	61.16
	Hoshiarpur	3996.80	20528.08	6340,31	58.61
	Ropar	4330.26	22651.15	7152.65	65.19
	Patiala	2943.05	16523.81	5330.00	81.10
	Pooled	4096.58	21070.42	6581.33	60.67
II.	*Cotton Belt*				
	Ferozepur	2760.07	10998.59	3963.78	43.62
	Faridkot	2628.65	12793.00	4321.96	64.42
	Bathinda	2361.50	11159.52	3682.84	55.95
	Sangrur	2393.27	9915.79	3080.44	28.70
	Pooled	2535.87	11216.72	3752.24	48.17
III.	*Misc. Crop Belt*				
	Kapurthala	2997.74	16787.68	5595.67	86.65
	Amritsar	2373.95	8418.82	2630.62	10.82
	Ludhiana	2626.56	13281.04	4330.29	64.88
	Pooled	2666.08	12829.18	4185.52	54.12
	State as a whole	2770.41	12440.93	4012.90	44.78

Table 3 : Decomposition Analysis of Growth in Value Productivity of Major Traditional Commercial Crops in Different Districts of Punjab for 1975-76 through 1989-90

Crop Belts Districts	Factors Contribution						
	Price effect	Yield effect	Cropping pattern effect	Yield × Price effect	Crop. patt. × price effect	Crop. patt. × yield effect	Yield × Crop Patt. × price effect
I. *Sugarcane Belt*	8.26	62.16	20.04	2.82	0.55	6.05	0.12
Jalandhar	3.50	5.29	70.74	1.40	5.63	14.02	- 0.58
Hoshiarpur	5.98	52.11	33.12	2.01	0.45	6.73	- 0.40
Ropar	2.65	12.28	68.98	2.53	6.64	32.97	- 1.49
Patiala	+ 0.28	1.65	71.00	1.71	5.82	49.60	- 0.30
II. *Cotton Belt*							
Ferozepur	- 16.20	121.67	0.73	- 8.06	- 2.79	5.25	- 0.60
Faridkot	- 8.93	97.49	12.02	- 6.07	- 4.65	12.48	- 2.30
Bandinda	- 4.98	77.58	24.52	- 2.76	- 9.58	19.18	- 3.96
Sangrur	9.81	40.53	64.55	- 3.58	- 22.95	12.23	- 0.58
III. *Misc. Crop Belt*							
Kapurthala	8.26	62.16	20.04	2.82	0.55	6.05	0.12
Amritsar	19.52	12.13	- 86.07	4.76	19.22	123.33	7.11
Ludhiana	- 2.20	2.61	74.64	0.73	8.90	15.70	- 0.38
State as a whole	- 1.87	67.94	20.94	- 1.86	- 6.95	24.96	- 3.16

tion of price, yield, cropping pattern and their interaction (with the exception of yield x cropping pattern × price) was positive in the districts falling in crop belt I where sugarcane dominates. Among the various factors, the contribution of price, yield and yield × price effect was maximum in Gurdaspur (8.26, 62.16 and 2.82 per cent) cropping pattern in Jalandar followed by Ropar with 70.74 and 68.98 per cent, cropping pattern × price effect in Ropar with 6.64 per cent and cropping pattern × yield in Patiala with 49.60 per cent respectively. So far as the contribution of yield x cropping pattern x price was concerned, it was negative in all the areas falling in belt. in the State. In case of crop belt II consisting of the districts dominating in cotton, the contribution of yield, cropping pattern and cropping pattern × yield was positive whereas the remaining interaction terms such as yield × price, yield × price × cropping pattern, cropping pattern × price contributed negatively in all districts of this belt. In case of the price effect, the contribution was negative in all the districts of this belt with the exception of Sangrur where the price contribution was positive and substantially high. This may probably be due to the favourable prices of groundnut and sugarcane as these crops covered substantial proportion of the area under commercial crops in the district.

With respect to crop belt III where more than one commercial crop recorded increase in area, the contribution of yield, yield × price, cropping pattern × price and cropping pattern × yield effect was positive in all the districts. However, yield effect was maximum (62.16 per cent) in Kapurthala, yield × price, cropping pattern × price and cropping pattern × yiled effect in Amritsar, with 4,76, 19.22 and 123.33 per cent respectively. Cropping pattern as an individual factor yielded the maximum in Ludhiana district of this belt in the state. So far as pooled situation at the state level is concerned, yield effect, cropping pattern effect and cropping pattern x yield effect contributed positively towards growth in productivity of commercial crops with 67.94, 20.94 and 24.96 per cent respectively. All the remaining factors contributed negatively at the state level. Thus, price effect individually and in interaction terms contributed negatively in case of areas dominated by cotton production whereas its contribution was positive in areas dominated by sugarcane production. Yield effect and yield x cropping pattern effect contributed positively in all the districts falling in different crop belts of the State.

Conclusions & Policy Implications

Three crop belts on the basis of concentration of area under a particular commercial crop have appeared in the State. The productivity is highest in the sugarcane belt and the lowest in cotton belt. In respect of contribution of factors toward growth in productivity, price effect yielded positively in sugarcane area whereas its contribution was negative in the cotton growing areas. So far as yield and yield × cropping pattern effects were concerned, their contribution was positive in all the districts. The specialisation of commercial crops in particular areas provides us guidelines for establishing sugar mills in the sugarcane belt and strengthening cotton industry in districts falling in the cotton belt. Oil extracting plants need to be established in Amritsar district where more than 70 per cent of the area under commercial crops is under rapeseed and mustard. Apart from this, remunerative price policy and strengthening of research on commercial crops would be helpful in diversification favouring commercial crops in the State. □

Feature

Performance of Tank Irrigation in Tamil Nadu

T.R. Shanmugam & K. Palanisami

Linear regression models have been used to evaluate the factors influencing the extent of tank irrigation in Tamil Nadu using data from 1961 to 1986. The districts are classified into intensive and non-intensive based on the irrigation intensity. Tank irrigated area has increased in intensive districts over the period due to effective tank management and maintenance. On the other hand, tank irrigation has decreased in non-intensive districts over the years due to lack of soil conservation measures and inadequate tank-water management. Seasonal rainfall is the primary factor which influences the extent of tank irrigation in this state. Increase in population in the form of unauthorised tank-bed cultivation, foreshore encroachment and settlement have contributed much to the decline in the extent and reliability of tank irrigation in Tamil Nadu.

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Tank irrigation is an established practice in most districts of Tamil Nadu. In this state, the monsoon rains fall erratically during a few months of the year, and irrigation tanks serve to store and regulate water flow for agricultural use. In Tamil Nadu, tanks are used primarily for rice production. Thus tank water management is a technology that provides a continuous flow of water with low mineral content for rice cultivation without salinifying the soil.

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Despite these advantages, the tank irrigated area in Tamil Nadu over the two decades has tended to stagnate and fall in some districts. From a source of relative stability, tank irrigation has become more unreliable and in many areas, it now is a source of increasing instability in agricultural production. These observations prompted us to study the factors contributing to changes in gross tank area and draw inferences that would point to future action. The study is based on the secondary data on gross tank irrigated areas spread over 14 districts of Tamil Nadu.

Historical Review

Ludden (1978) observed that tank construction in the past played a vital role in managing land and water resources in Tamil Nadu. The irrigation system as a whole grew in a cellular segmented manner. In the tank irrigation system, irrigation facilities were constructed,

maintained and regulated by the same organisational units that controlled crop production processes as a whole. The British were highly impressed by the extent of tank irrigation in this state. In 1853, R.B. Smith observed that the extent to which tank irrigation had been carried throughout the Madras Presidency was truly extra-ordinary and excellent.

The extent of tank irrigation today is about the same as it was a century ago (table 1). Tank irrigated area has decreased in non-tank intensive districts viz., Salem and Coimbatore. On the other hand, tank irrigation has slightly increased in Chengleput, North Arcot, South Arcot, Trichy and Tirunelveli. In Tamil Nadu there has been hardly any improvement in the extent of tank-irrigation during the last 100 years.

Table 1 : Area Irrigated by tanks, and total cropped area in the region of the old Madras Presidency, 1882-83 and 1969-72

District	1882 - 83		Average for 1969-72			
	Total Cropped Area ('000 HA)	Net Area Irrigated By Tanks ('000 HA)	Total Cropped Area ('000 HA)	Net Area Irrigated By Tanks ('000 HA)	(3) (1)	(4) (2)
	(1)	(2)	(3)	(4)	(5)	(6)
SALEM	75	39	924	32	12.3	0.8
COIMBATORE	57	18	837	5	14.6	0.3
MADURAI	94	64	648	53	6.9	0.8
CHINGLEPUT	174	127	433	164	2.5	1.3
NORTH ARCOT	137	81	643	105	4.7	1.3
SOUTH ARCOT	161	86	723	108	4.5	1.3
TANJAVUR	42	18	875	30	20.8	1.6
TIRUNELVELI	152	59	557	76	3.6	1.3
TIRUCHIRAPPALI	100	53	822	79	8.2	1.5
TOTAL	1421	785	11614	939	8.2	1.2

Source : Tamil Nadu Season and Crop Reports, 1969-72

In contrast, the total cropped area in the state has increased about eight times during the last century. Thus while tank irrigation was available for over about 50 per cent of the total cropped area in the last century, it is available now to about 10 per cent of the total cropped area. Differences in the development of tank irrigation over time can be largely explained by rainfall, population and other institutional factors. Historians and anthropologists have pointed out that there is a direct relationship between population and tank irrigation, one reinforcing the other (Ludden, 1978).

Initially, where physically feasible and economically attractive, tank irrigation systems were expanded till the population density crosses the threshold level. Beyond this level, further population pressure may tend to adversely affect existing irrigation systems and so special measures may be required to preserve the capital invested in irrigation tanks. Generally gross tank irrigated area decreases with an increase in population.

The development of tank irrigation in Tamil Nadu was also influenced by other institutional factors. Abolition of ownership right for private tanks stopped private investments in tank irrigation. This also decreased the efficiency of water control and tank management. With the abolition of old land tenure system, the small tanks became common property and suffered due to inefficient management. The other important reasons for change in the extent of tank irrigation may be due to lack of soil conservation, deforestation in the catchment areas leading to flash runoff, increase in tank-bed siltation, unauthorised tank-bed cultivation, foreshore encroachment and seasonal distribution of rainfall.

Empirical Model

The variability in the gross tank irrigated area is probably a function of population pressure, seasonal rainfall (North-east monsoon and South-west monsoon) and other variables which are directly related to time and are attributable to changes in the environment over years. Time as an independent variable will take care of physical factors such as soil conservation measures, technology, deforestation and siltation over years.

The variability in the gross tank irrigated area is probably a function of population pressure, seasonal rainfall and other variables directly related to time and attributable to changes in the environment.

Population in numbers as independent variable will include the effect of foreshore encroachment, settlement, unauthorised cultivation and over grazing in the catchment areas. Rainfall measured in mm. has been divided into North-east monsoon (October, November and December) and South-west monsoon (June, July, August and September) and included separately in the model to assess the impact of each rainfall season on gross tank irrigated area. Gross tank area measured in hectares has been included in the model as dependent variable. It is calculated by multiplying net tank irrigated area by tank irrigation intensity of the district. The time series data for the present study are taken from seasonal and crop reports of Tamil Nadu from 1961 to 1986

(latest year) for 14 districts and are pooled for analysis. Data on North-east monsoon rainfall in mm. and South-west monsoon rainfall in mm. are collected from the seasonal and crop reports and data on population are computed based on census reports for 1961, 1971, 1981 and 1991. The following linear model has been fitted to explain the factors affecting gross tank irrigated area.

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + U$$

where, Y = The gross tank irrigated area in hectares.

x_1 = Time in number of years 1961=1 to 1986=26

x_2 = North-east monsoon rainfall in mm (October, November and December)

x_3 = South-west monsoon rainfall in mm (June, July, August and September)

x_4 = Population in numbers

a = Constant term

b_1, b_2, b_3, b_4 are the parameters to be estimated

U = Error Term

Two linear functions specified below are fitted by pooling the data based on the intensity of tank irrigation. The classification of districts is given in table 2.

Table 2 : Classification of Districts

Criteria intensive districts	Tank non-intensive districts	Tank
The ratio of gross tank area to net area is greater than one	Chengleput, South Arcot, North Arcot, Madurai, Ramanathapuram, and Tirunelveli	Salem, Dharmapuri, Coimbatore, Trichy, Tanjore, Nilgiri, Kanyakumari and Pudukkottai

(a) Pooling data for the tank intensive districts viz., Chingleut, South Arcot, North Arcot, Madurai, Ramanathapuram, Tirunelveli; for these districts the ratio of gross tank area to net tank area is greater than one.

(b) Pooling data for the tank non-intensive districts viz., Salem, Dharmapuri, Coimbatore, Trichy, Tanjore, Nilgiri, Kanyakumari and Pudukottai; for these districts the ratio of gross tank area to net tank areas is less than or equal to one.

Results

The results of the linear regressions are presented in table 3. For the tank intensive districts, based on the criteria, all the selected variables are significant. Time, north-east monsoon rainfall and south-west rainfall have positive sign but population has negative sign. The positive sign for time indicates that soil conservation measure and adequate care to maintain tanks are practised in tank intensive districts. Population has a negative influence on gross tank areas and it may be due to foreshore encroachment and unauthorised cultivation in these districts.

In terms of prior expectations, explanatory variables in these models have expected signs. The R^2 values are significant. The results can be interpreted as follows : Holding all other variables constant, the gross tank area is estimated to increase at the rate of 3960 hectares per year in tank intensive districts and it decreases by 545 hectares per annum in tank non-intensive districts. Thus the abolition of institutional factors has affected the tank area in non intensive districts. Keeping all other variables constant, the gross tank area is found to decrease by 0.1073 hectares and by 0.0035 hectares respectively in intensive and non-intensive districts as population increases by one number. The result implies that the tank irrigated area decreases with an increase in population density. If other things are constant, the gross tank area is estimated to increase at the rate of 115 hectares and 37 hectares per mm. of rainfall during north east monsoon in intensive and non intensive districts respectively. By the same token, the gross tank area is found to increase by 54 hectares and 6 hectares, respectively in intensive and non intensive districts per mm. of rainfall in south west monsoon. The analysis shows that the rainfall in general shifts the tank irrigated area upward and its impact is higher in tank intensive districts in both seasons, compared to tank non intensive districts.

Table 3 : Linear regression model

Districts		Constant	Time	North-east Monsoon	South-west Monsoon	Population	R^2	$\bar{R}^2$	F
Tank Intensive	b	394369.9289	3959.6940	54.4708	114.5142	-0.1073	0.6688	.6599	76.2184
	SE	23.397.1438	613.9719	15.5996	19.3333	0.0076			
	t	16.8554	6.4490	3.4920	5.9230	-14.1110			
Tank non-intensive	b	49.428.6501	-545.1019	6.4484	37.1669	-0.0035	0.4100	0.3977	33.3596
	SE	8.771.6235	244.9605	8.8471	8.3598	0.0016			
	t	5.6351	-2.2250	0.7290	4.4460	-2.1920			

For tank non-intensive districts, based on the criteria, time and population are negative but significant variables. Deforestation, lack of soil conservation and siltation over the years reduced the storage capacity of the tank causing decrease in gross tank area. As expected, the encroachment, grazing and unauthorised cultivation are higher in tanks of non-intensive districts due to poor storage capacity and poor maintenance. This may be attributed to the negative sign for the population. Tank irrigation in parts of Tamil Nadu (non-tank intensive districts) is decreasing in extent though it has potential and is economically beneficial. Major factors causing the decline in gross tank irrigated area in tank non-intensive districts include deforestation, lack of soil erosion and siltation, all of which are related to environmental degradation over years. These problems accumulated over time reduced the effective storage capacity of the tanks in tank non-intensive districts. Other factors include unauthorised cultivation, over grazing and foreshore encroachment which are related to increase in population densities. It was observed in both tank intensive and non-intensive districts.

The improvement of tank irrigation for all districts would require a more balanced integration of farmers' involvement, government commitment and people's participation in activities such as control of water distributing, maintenance and repair, revenue collection and management of tank.

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Trouble Can Become Triumph If you . . .

- Keep a clear head and a determination to meet the situation with every weapon you have.
- Think of every possible avenue of relief and select the best one scientifically.
- Keep fighting with the sure knowledge that everything gives way before intelligent determination.
- Never forget that trouble makes possible a greater achievement that you could have hoped for without it.

Source : Charles A Cerami : How to Solve Management Problems, Englewood, Prentice Hall

Agricultural Productivity & Input Use in U.P. Hills

Fahimuddin

This paper examines the productivity performance of agriculture in the U.P. hills over a decade in comparison with the other economic regions of Uttar Pradesh. It identifies the factors involved and suggests suitable policy recommendations concerning input use to augment productivity.

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The performance of Indian agriculture in the post Green Revolution period has been remarkably impressive. However, the use of seed-irrigation-fertilizer technology remained confined to few limited crops. Hence, the agricultural growth strategy based on new technology with its selective crop-area approach created spatial disparities in crop productivity levels across the country. Some areas endowed with higher potentials of resource base and input use attained higher levels of per hectare yield than others. No doubt, thanks to the new technology, the areas with lower infrastructure and resource use intensity have also achieved higher growth in per hectare output. However, there was a great disparity in growth and the phenomenon led to doubts as to whether the new package can really bring about all round agricultural growth in the country when the resource base, infrastructure and geo-physical conditions vary so vastly from one area to another. Naturally the attention got focussed on the areas which were left out of the coverage of new technology vis-a-vis crops. Yet considerable gap in crop productivity continued to exist across the different areas.

Agriculture in U.P. Hills

The hill region is one of the five economic regions of Uttar Pradesh. Situated in the northern part of the state, it comprises eight districts, viz. Almora, Pithoragarh, Utterkashi, Garhwal, Chamoli, Tehri-Garhwal, Dehradun and Nainital. To the north of the region lies China, to the east Nepal, to the west Himachal Pradesh and to the south the plains of the state. Its population according to the 1981 census was 48.36 lakhs and area 51, 125 sq. kms. which constituted 4.36 per cent and 17.40 per cent respectively of the total population and area of the state. Agriculture remains the bedrock of the region's economy. Quite deservedly, therefore, the examination of the comparative level of agricultural development of the hill

Table 1 : Region-Wise Cropping Intensity, Gross Value and Productivity of Agricultural Produce (At Current Prices)

Regions	Cropping Intensity	Gross Value Agricultural Produce* (Rs. at Current Prices)			Productivity of Important Crops in 1988-89** (Quintals/hectare)				
		Per Capita	Per ha. Gross Cropped Area	Per ha. Net Sown Area	Paddy	Wheat	Oilseeds	Sugarcane	Potato
Hill Region	164.27	1076	5455	8960	19.86	17.22	5.24	543.68	184.84
Western Region	149.04	1254	6314	9411	22.82	26.69	9.30	531.85	202.08
Central Region	133.24	933	5314	7080	18.68	22.51	7.56	438.06	164.28
Eastern Region	148.49	877	5024	7460	15.21	20.56	4.95	443.45	165.18
Bundelkhand Region	111.05	1383	4135	4592	9.73	13.23	4.79	383.58	183.98
Uttar Pradesh	142.56	1054	5488	7823	17.52	22.54	7.72	502.60	183.98

Sources * District-Wise Indicators of Development, 1990.
** *Uttar Pradesh ke krishi Aankre*, Directorate of Agriculture, Government of Uttar Pradesh, 1988-89.

region vis-a-vis other regions of the state continues to be a matter of research among social scientists. An obvious and frequently employed technique has been to compare the level of agricultural development of the hill region with other regions and the state as a whole using well known indicators of development like cropping intensity, gross value of agricultural produce per capita at current and constant prices, gross value of agricultural produce per hectare of net and gross sown area and productivity levels of various crops etc. When the values of these indicators were analysed in the spatial context, the hill region of U.P. emerged as one of the agriculturally advanced region of the state (Table 1). But the observed level of agricultural development in the hill region is quite unreal and misleading. Included in the eight districts of the region are, Nainital and Dehradun which have substantial plain and fertile area and rank among the most developed districts of the state. When the agricultural development of the two districts which have negligible characteristics of a hilly area are excluded from the other six constituent districts of the hill region, the scenario altogether changes. The hill region emerges as one of the agriculturally backward regions of the state (Table 2). It is also evident from the disaggregated data placed in table 2 that despite the exclusion of the Nainital and Dehradun districts from the hill region,

Table 2 : Cropping Intensity Gross Value and Productivity Levels of Agricultural Produce (at Current Prices)

Regions	Cropping Intensity	Gross Value Agricultural Produce* (Rs. at Current Prices)			Productivity of Important Crops in 1988-89** (Quintals/hectare)				
		Per Capita	Per ha. Gross Cropped Area	Per ha. Net Sown Area	Paddy	Wheat	Oilseeds	Sugarcane	Potato
Almora	169.07	653	3098	5238	10.82	9.65	6.58	—	183.78
Pithoragarh	180.43	1139	4635	8364	11.39	12.90	6.23	502.60	183.98
Tehri-Garhwal	162.61	619	2951	4798	13.19	11.02	4.24	—	183.98
Utterkashi	153.28	853	3906	5988	12.83	13.08	4.27	—	183.98
Garhwal	152.40	519	2482	3782	10.69	11.09	4.93	502.60	183.98
Chamoli	154.56	556	3889	6010	12.16	10.62	4.94	—	183.98
Hill Region (exluding Nainital & Dehrdun)	161.05	723	3493	5697	11.80	11.29	4.98	502.60	183.94
Western Region	149.04	1254	6314	9411	22.82	26.69	9.30	531.85	202.08
Central Region	133.24	933	5314	7080	18.68	22.51	7.56	438.06	164.28
Eastern Region	148.49	877	5024	7460	15.21	20.56	4.95	443.45	165.18
Bundelkhand Region	111.05	1383	4135	4592	9.73	13.23	4.79	383.58	183.98
Uttar Pradesh	142.56	1054	5488	7823	17.52	22.54	7.72	502.60	183.98

Sources * District-Wise indicators of Development, State Planning Institute, U.P., 1990
** *Uttar Pradesh Ke Krishi Aankre*, Directorate Of Agriculture, Government Of Uttar Pradesh, 1988-89.

the cropping intensity in the remaining six districts continue to remain highest as compared to the all other regions of the state while the level of agricultural development emerged to be least there. Thus the six districts which represent the hill region of U.P. in the real sense, exhibit a situation in which the crop cultivation was extremely intensive but returns from it were extremely low. This paradoxical situation indicated that the productivity levels of most of the crops are low in U.P. hills. This phenomenon gets support from the data in table 2 which show that productivity of most of the important crops was far lower in U.P. hills as compared to the other regions of the state. Thus, the productivity enhancement of the major crops is the most crucial step in any strategy designed to develop the agriculture in the U.P. hills. The purpose of this paper is to (i) examine the productivity dynamism over a decade in one of the main crops of the U.P. hills; (ii) identify factors influencing productivity at the present level of agricultural development; (iii) identify the constraints in the productivity boost; and finally (iv) to suggest suitable policy recommendations to increase agricultural productivity in the U.P. hills.

The productivity levels of most of the crops are low in U.P. hills.

Materials and Methods

Both secondary and primary data were used. The secondary data regarding cropping intensity and productivity levels of different crops in regional as well as at the inter-district level were obtained from the Office of the Director of Agriculture, Government of U.P. The secondary information regarding the gross value of agricultural produce per capita and per hectare of net cropped area were taken from the publication 'District-Wise Indicators of Development', State Planning Institute, Government of U.P. The analysis of secondary information was disaggregated at the district level to exclude Nainital and Dehradun from the list of districts comprising hill region in official records because these two districts have substantial plain area and have little resemblance with the rest of the six hill districts in terms of agricultural development. Paddy crop was chosen as a case to examine because paddy was cultivated in about 25 per cent of the gross cropped area of the hill region of the U.P. The compound growth rates were worked out by using the following formula:

$$r = (\text{ant. log}\left[\frac{(\log pt - \log po)}{(t)}\right] - 1)\ 100$$

where r is the growth rate, log pt = log x1 + log x2 + log xn, log po = nx log x1 and $t = n\left[\frac{(n-1)}{(n-2)}\right]$

The factors explaining the variation in paddy productivity were analysed by using the following form of production function:

$$y = ax1^{b1}\ x2^{b2}\ .....\ xn^{bn}$$

where y is the output per hectare (quintals) and $x_1, x_2 ....$ xn are the input used. To be more specific, the production function of the following type was fitted:

$$\text{Log } y = \log a + b1 \text{ Log } x_1 + b2 \text{ Log } x_2 \ldots b_n \log x_n$$

The dependent variable considered in the equation is the productivity per hectare. The independent variables are the major inputs like seed, family labour, hired labour, irrigation and fertilizer. The land as independent variable has not been considered because area may alone explain high variation in productivity and may be highly correlated with other variables. For the estimation of the functional relationships, ordinary least square method was employed. Simple correlation of coefficients were also worked out to get an idea of association between variables, included in the model. The functional relationship analysis was based on the primary information collected from 60 farmers of Almora district, 60 farmers of the Tehri-Garhwal district totalling 120 farmers. These farmers owned land holdings of less than 0.50 ha. to 2.01 ha. and above.

Findings

(a) Changes in Paddy Productivity

Paddy is the main kharif crop cultivated by most of the farmers in the hill region of U.P. Its yield level in hill region was between 10 to 12 quintals per hectare during 1980-81 to 1990-91 while at the state level, it was just double. The paddy yield increased considerably during the reference period in the state while it remained almost stagnant in U.P. hills. The paddy yield in U.P. hills showed a compound growth of only 0.44 per cent during 1980-81 to 1990-91 as compared to 1.10 per cent, 2.17 per cent, 1.25 per cent, 3.52 per cent and 5.21 per cent respectively in the western region, central region, eastern region, Bundelkhand region and the state as a whole

(table 3). The growth of paddy productivity was also marked by the higher degree of intra-regional (inter-district) disparities. While Almora district showed a growth of around two per cent and Utterkashi district less than one per cent, in the remaining four districts of Pithoragarh, Tehri-Garhwal, Garhwal and Chamoli, the growth in paddy productivity was negative. Thus, during more than a decade, the growth in the paddy yield in U.P. hills has been negligible.

Table 3 : Compound Growth Rates of Paddy Productivity in U.P. Hills from 1980-81 to 1990-91

Districts/Regions	Compound Growth Rates
Almora	2.19
Pithoragarh	-1.18
Tehri-Garhwal	-3.71
Utterkashi	0.44
Garhwal	-1.08
Chamoli	-0.16
Hill Region (excluding Nainital & Dehradun)	
Western Region	1.10
Central Region	2.17
Eastern Region	1.25
Bundelkhand Region	3.52
Uttar Pradesh	5.21

Source: Directorate of Agriculture, Govt. of U.P. Lucknow.

Factor-Product Relationship

It is a commonly known fact that the input use and productivity are related to each other and productivity differentials can be explained by the level of inputs used. If the modern inputs of seed, fertilizer and irrigation have weak relationship with productivity in any agrarian economy, then the productivity levels are bound to be lower. Therefore, keeping in view the low productivity of paddy in the U.P. hills, the simple correlation coefficients were worked out between the productivity of paddy and five main inputs used in its cultivation by the sample farmers of the Almora and Tehri-Garhwal districts and the results were placed in table 4 :

Table 4 : Coefficient of Correlation between Productivity of Paddy and Other Variables of Sample Farmers in the Hill Districts

Variables	Correlation Coefficients		
	Almora	Tehri Garhwal	Combined
Paddy Seed and Paddy Productivity	0.2359	0.3726	0.2336
Paddy Labour and Paddy Productivity	0.9580*	0.9469*	0.9499*
Hired Labour and Paddy Productivity	0.2336	0.2538	0.2487
Fertilizer and Paddy Productivity	0.2955	0.3232	0.3197
Irrigation and Paddy Productivity	0.4611**	0.4952**	0.4883**

* Significant at one percent level.
** Significant at ten per cent level.

The above table revealed very high and statistically significant correlation between family labour and the paddy productivity in Almora, TehriGarhwal and combined level of both the districts. Thus, it was evident that at the present level of paddy productivity in the U.P. hills, the contribution of the modern inputs of seed-irrigation-fertilizer was not significant enough, which resulted in low productivity of paddy.

Since family labour alone was found to be significantly correlated with paddy productivity at the three spatial levels of U.P. hills, this variable alone was considered in the regression model first. Later on other variables were also included in multiple regression equations and the results obtained were placed in table 5. The table revealed that family labour alone explained about 13 per cent, 14 per cent, and 14 per cent of the variations in paddy productivity in Almora, Tehri Garhwal and at both places. It was also found to be statistically significant at one per cent level. But when all the five selected indicators were considered in the regression equations, it was found that except the coefficient of irrigation which was significant at 10 per cent level, none of the variables show significant relationship and the explanatory power of the equation (R^2) fell down. All the equations thus estimated were also not significant statistically.

Keeping this trend in mind, one can infer that in the present paddy cultivation, family labour was one of the most crucial variables for productivity variations. Irrigation was also an important variable but its significance level was low compared to family labour. Low coefficients of fertilizer and seed in the estimated equation

Table 5 : Regression Estimates

Districts	No. of Obser-vations	Regression Coefficent						
		Constant	Seed	Family Labour	Hired Labour	Fertlizer	Irrigation	R^2
Almora	60	5.382	—	0.279* (2.4676)	—	—	—	0.1269**
Tehri Garhwal	60	6.638	—	0.285* (2.4879)	—	—	—	0.1438**
Combined	120	5.793	—	0.360* (2.1097)	—	—	—	0.1370**
Almora	60	3.620	0.038 (0.2114)	0.403* (1.834)	-9.115 (0.677)	0.063 (0.3913)	0.2032*** (0.8990)	0.0976
Tehri Garhwal	60	4.389	0.040 (0.2893)	0.419* (0.419)	-0.113 (0.593)	0.058 (0.3562)	0.2250*** (0.9011)	0.0996
Combined	120	4.216	0.028 (0.2773)	0.379* (1.845)	-0.114 (0.563)	0.596 (0.3272)	0.1839*** (0.7577)	0.0868

* Significant at one per cent level; ** Significant at five per cent level; *** Significant at ten per cent level.

Note. Figures in brackets are the standard errors.

indicated that the farmers in U.P. hills may be unaware of the fact that seed, fertilizer when applied with irrigation can provide substantial yield. They may be satisfied with the assumption that irrigation alone raises productivity.

Conclusions & Suggestions

Thus, the above analysis of the study of agriculture in U.P. hills and paddy productivity dynamism and the factor-product relationship reveals the following:

- The U.P. hills are one of the agriculturally most backward areas of the U.P. State. The disaggregated data showed considerable inter-district disparities in agricultural development after the exclusion of Nainital and Dehradun from the list of districts comprising the hill Region of U.P. This finding is contrary to the general notion that agriculture in the U.P. hills is developed.

Increasing and strengthening of the resource base, namely irrigation and promotion of application of HYV seed and fertilizer will accelerate the productivity level.

- There is not much impact of modern technology on the agricultural produce and breakthrough has not been achieved at all.
- Increasing and strengthening of the resource base, namely irrigation and promotion of application of HYV seed and fertilizer will accelerate the productivity level.

In view of the above, it would be most relevant first to lay emphasis on the productivity enhancement of the food crops. Cropping pattern changes in terms of subsistence crops to high valued crops or animal husbandry promotion would not serve the purpose because it is the experience of most of the developed regions in the country that only after the first break-through in food production they could diversify their economies. Moreover, the hill areas in particular, with very poor infrastructural facilities, may not find comparative advantages in the promotion of other sectors except that in agriculture. Since most of the work force in the hill region of U.P. is dependent on agriculture the use of modern inputs needs to be enhanced if the process of the socio-economic development is to be accelerated. The package of new technology use in plain areas cannot be totally accepted for application in hill areas because of the topographical problems. Therefore, new technology package exclusively suitable to local conditions must be evolved. Thus the entire programme of agricultural productivity enhancement in U.P.hills is required to be framed and implemented according to local conditions and needs.

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A Study of the Agrarian Structure

Balishter

The agrarian structure has a vital bearing on the productivity and hence the identification of all the essential factors involved in it assumes importance. This study analyses the prevalent agrarian structure in a sample village and presents the results and recommendations.

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Agrarian structure, refers to on the one hand the structure of resources, i.e. the proportion in which the different resources are combined in the aggregate resource mix employed for any unit of agricultural production; and, on the other, the structure of production, i.e. proportion in which the different products are obtained in the aggregate product mix at any point of time at the given national, regional, area, village or farm levels. The quantum and type of investments, the nature of land ownership and tenancy rights, type of human labour employed in production, the quantum and type of production and institutions providing credit, marketing and the supporting technical services etc. constitute the various elements of agrarian structure.

The agrarian structure in a number of developing countries including India is undergoing a rapid change under the impact of demographic pressures and technological changes. The problem is to make it responsive to the developmental efforts to achieve a higher rate of agricultural growth. But the impact of such changes is different in different areas, though the impact of demographic pressures as a change factor is common to all to a marked extent.

The growth rate in Indian agriculture has not been satisfactory. As against the desirable long-term agricultural growth rate of 4 per cent, actual achievement was only 3.13 per cent per annum recorded for the period 1949-50 to 1964-65 and 2.66 per cent per annum between 1967-68 and 1984-85 (Gangadharan,1986). It may, therefore, be necessary to make micro-level studies of the agrarian structure with a view to examine and identity the structural deficiencies responsible for the low rate of agricultural growth. With this objective in view, the present study was taken up in Sadarban village in C.D. Block Bichpuri of Agra district in Uttar Pradesh on a census basis.

Methodology

Our study is confined to one village, namely, Sadarban in C.D.Block Bichpuri in Agra district. All the farming families owning land in the village numbering 128 in all, were taken up for study. They were categorized into four groups on the basis of owned holding. viz. marginal (having land upto 1 ha), small (1 to 2 ha), medium (2 to 4 ha) and large (above 4 ha). The agricultural year 1987-88 was the reference period and data were collected by survey method through personal interview with the help of schedules and questionnaires specially designed for the purpose.

Salient Features of the Sample Village

The total number of families in the village is 130 of which 128 families own land and 2 families are landless. The total cultivated area in the village is 231.75 hectares and the entire area has irrigation facilities. The sources of irrigation are canal and private tubewells numbering 40. There are 6 tractors in the village.

Land Redistribution

The total number of landless families in the sample village prior to land redistribution in October 1975 was 34 including 15 scheduled caste and 19 non-scheduled caste families. The total surplus land (Panchayat land) available for redistribution was only about 7.5 hectares, which was distributed equally among 34 landless families on Oct. 7, 1975, each family getting about 0.22 hectare of land. The entire allotted land was of good quality and located at one place in a consolidated form to facilitate joint or cooperative farming by the allottees. But no allottee agreed to joint cultivation of this land. Category-wise number of farm families and owned area is given in table 1.

Table 1 : Number of farm families and owned area (1987-88)

Category of farmers	Total number of farm families	Percentage to total	Total area owned (Hect.)	Percentage to total owned area	Average owned area per family (Hect.)
Marginal	51	39.84	17.84	7.70	0.35
Small	45	35.16	70.36	29.39	1.56
Medium	22	17.19	64.87	28.96	2.95
Large	10	7.81	78.68	33.95	7.87
All	128	100.00	231.75	100.00	1.81

There exists a marked inequality in the distribution of cultivated land among the farming families in the village. Such a holding structure may not be conducive to efficient land use, particularly in case of the marginal farmers and the large farmers.

There exists a marked inequality in the distribution of cultivated land among the farming families in the village.

Sources of Irrigation

The area irrigated by different sources of irrigation shown in table 2.

Table 2 : Area Irrigated by different sources (hectares)

Category of farmers	Number of farmers	Area Irrigated by			Total
		Canal	Private tubewell	Private tubewell + canal	
Marginal	51	1.88 (10.54)	7.90 (44.28)	8.06 (45.18)	17.84 (100.00)
Small	45	2.86 (4.06)	38.97 (55.39)	28.53 (40.55)	70.36 (100.00)
Medium	22	11.51 (17.74)	33.76 (52.04)	19.60 (30.21)	64.87 (100.00)
Large	10	7.75 (9.85)	46.80 (59.48)	24.13 (30.67)	78.68 (100.00)
All	12	24.00 (10.36)	127.43 (54.99)	80.32 (34.6 5)	231.75 (100.00)

Note : Figures within brackets indicate percentage to total in each category.

The area irrigated exclusively by canal accounts for only about 10 per cent of the total cultivated area. The area exclusively irrigated from private tubewells accounts for about 55 per cent of the total cultivated area while the tubewells as supplemental source to canal irrigated area cover about 35 per cent of the total cultivated area. Thus tubewells are the most important source of irrigation in the village.

Farm Resources

The distribution of farm resources is unequal in the different farm categories (table 3). The medium and large farms—about 25 per cent of the total—account for

Table 3 : Distribution of farm resources by farms category

Category of farmers	Number of farms	Number of bullock pair	Number of tubewells	Number of tractors	Number of Permanent farm workers		
					Family	Hired	Total
Marginal	51 (39.84)	1 (9.10)	5 (12.50)	-	61 (38.60)	-	61 (37.66)
Small	45 (35.160	4 (36.36)	13 (32.50)	-	54 (34.18)	-	54 (33.33)
Medium	22 (17.29)	3 (27.27)	13 (32.50)	2 (33.34)	26 (16.46)	-	26 (16.05)
Large	10 (7.81)	3 (27.27)	9 (22.50)	4 (66.66)	17 (10.76)	4 (100.00)	21 (12.96)
Total	128 (100.00)	11 (100.00)	40 (100.00)	6 (100.00)	158 (100.00)	4 (100.00)	162 (100.00)

Note: Figures within brackets indicate percentage to total

about 55 per cent of the bullock units, 55 per cent of the tubewells and 100 per cent tractors. But the number of attached farm workers is higher on marginal (38%) and small farms (33%) as compared to medium (16%) and large farms (13%). This indicates that all farm resources (except farm workers) are concentrated on medium and large farms.

Leasing By Farm Size Group

Table 4 gives the number of farmers leasing-in or leasing-out land in different farm size groups. Out of 128 farmers in the village, 38 or about 30 per cent lease-in or lease-out land. Over 40 per cent of small and medium farmers lease-in or lease-out land while in case of marginal and large farmers, only 15 and 20 per cent lease-in or lease-out land respectively. Table 5 gives the extent of leasing-in land and leasing-out land in different categories of farmers.

Leasing-in and leasing-out respectively constitute about 10 and 14 per cent of the owned area, the total being over 24 per cent of the total. It is further revealed that the extent of leasing in land decreases with increase in farm size. In case of marginal and small farmers leasing-in and leasing-out is confined mostly within the same category.

This is due to the fact that marginal and small farmers generally do not lease-out to the large farmers due to the fear of non-repayment of rent. However, two marginal farmers leased-out land to large farmers to repay their debt. This belied the common impression that those who lease-out are large farmers and those who lease-in are small farmers. This situation mainly arises due to the redistribution of surplus land to landless families.

Absentee Owners

Of 24 owners engaged in leasing out land, 8 or about 33 per cent are absentee owners. They constitute about 43 per cent of the total leased out area. Thus a good part of the area leased-out belongs to absentee owners. Of the 8 absentee owners, 4 are small land holders who constitute about 41 per cent of the total area leased-out by absentee owners.

Table 4 : Number of farmers engaged in leasing-in or leasing-out land

Category of farmers	Total number of Farmers	Farmers leasing in land		Farmers leasing out land		Total	
		Number	Percentage to total farmers	Number	Percentage to total farmers	Number	Percentage to total farmers
Marginal	51	2	3.92	6	11.76	8	15.69
Small	45	8	17.78	11	24.44	19	42.22
Medium	22	2	13.64	6	27.27	9	40.91
Large	10	1	10.00	1	10.00	2	20.00
All	128	14	10.94	24	18.75	38	29.69

Table 5 : Areas leased-in and leased-out by category

Category of farmers	Total number of farmers	Total owned area (Hect)	Area leased in (Hect.)	Area leased out (Hect.)	Total operated area (Hect.)	Percentage to owned area		
						Leased in	Leased out	Total
Marginal	51	17.84	7.35	4.34	20.85	41.20	24.33	65.53
Small	45	70.36	12.09	14.52	67.93	17.18	20.64	39.07
Medium	22	64.87	6.38	5.21	66.04	9.84	8.03	17.27
Large	10	78.68	0.75	2.50	76.93	0.95	3.18	4.13
All	128	231.75	26.57	26.57	231.75	10.36	14.07	24.43

Caste & Extent of Lease

Analysis of data on leasing according to scheduled and non-scheduled caste families revealed that extent of leasing-out of operational area is higher (about 68 per cent) in case of scheduled caste as compared to non-scheduled caste (about 11 per cent) families. This is due to the fact that majority of scheduled caste families fall in the category of marginal farmers who have been provided tiny plots under the land redistribution programme. They do not maintain any farm asset for self cultivating the land.

Majority of scheduled caste families fall in the category of marginal farmers who have been provided tiny plots under the land redistribution programme. They do not maintain any farm asset for self cultivating the land.

Terms & Conditions of Lease

There are two types of lease, namely, share cropping on a 50 : 50 basis and fixed kind rent prevalent in the sample village. Under the crop-sharing system, the cost on new inputs, such as high-yielding seeds, fertilizers and canal dues are divided between the lessor and lessees equally, while the cost on labour both human and bullock are borne by the lessees and the land revenue by the lessor. In the fixed kind rent system, all the cultivating expenses except land revenue, are borne by the lessees. The land revenue is paid by the lessor. The rent in this system ranged from 10 to 15 quintals of wheat, depending on the quality of land and source of irrigation. Since wheat is the major and staple crop of the village, rent is paid in terms of wheat. In the village under study, leasing is on an annual basis. Leases of longer duration are not made by the owners mainly due to the fear that longer leases would entitle the lessees to the rights of ownership. The leasing arrangements are made orally.

The fixed kind rent system being more profitable is most prevalent in all categories of farmers as the whole economic surplus after meeting cultivation expenses goes to the farmer, provided kind rent is not high. Under cash rent system, lessees have to pay rent in advance while under fixed kind rent system, the produce is paid after the harvest of wheat crop. Most of the leasing is done by lower categories of farmers who find it difficult to pay cash. However, cash rent system is common in case of absentee owners.

Intensity of cropping

The average cropping intensity works out to about 163 per cent and varies from about 193 per cent on small farmers to about 140 per cent on large farms.

Cropping Patterns

Table 6 gives the distribution of cropped area under broader groups of crops by farm size group. The proportion of area under foodgrain crops decreases with the increase in farm size while the reverse is true for non-foodgrain crops.

Crop Output

Table 7 gives the gross output by major groups of crops. The proportion of contribution by foodgrain crops to total output decreases with increase in farm size while it increases with the farm size in the case of non-foodgrain crops. Among foodgrain crops, cereals account for about 77 per cent of the total output and it varies from about 90 per cent in marginal category to about 75 per cent in large category which shows decreasing trend with increase in farm size. Among non-foodgrain crops, oilseeds contribute about 7 per cent of the total output which is maximum and it varies from about 2 per cent in marginal category to about 9 per cent in medium category.

Table 6 : Area under broader groups of crops (hectares)

Crop	Cropped area				
	Marginal	Small	Medium	Large	All
Foodgrains					
Cereals	33.94 (84.24)	94.56 (78.41)	75.42 (68.98)	72.13 (67.23)	276.05 (73.12)
Other foodgrains	3.83 (9.51)	15.58 (12.92)	19.62 (17.94)	11.90 (11.09)	50.93 (13.49)
Total foodgrains	37.77 (93.75)	110.14 (91.33)	95.04 (86.92)	84.03 (78.31)	326.98 (86.61)
Non-foodgrains					
Oil seeds	0.98 (2.43)	7.26 (6.02)	7.30 (6.67)	7.84 (7.31)	23.37 (6.19)
Vegetables	0.75 (1.86)	2.46 (2.04)	2.38 (2.18)	5.28 (4.92)	10.88 (2.88)
Fodder crops	0.61 (1.51)	0.74 (0.61)	1.07 (0.98)	0.64 (0.60)	3.06 (0.81)
Others	0.18 (0.45)	-	3.55 (3.25)	9.51 (8.86)	13.24 (3.51)
Total Non foodgrains	2.52 (6.25)	10.46 (8.67)	14.30 (13.08)	23.27 (22.09)	50.55 (13.39)
Total (A + B)	40.29 (100.00)	120.60 (100.00)	109.34 (100.00)	107.30 (100.00)	377.53 (100.00)

Note: Figures within brackets indicate percentages.

Table 7 : Contribution to gross output by major group of crops (,000 Rs.)

Crop	Marginal	Small	Medium	Large	All
Foodgrains					
Cereals	132.21 (89.90)	385.10 (81.09)	312.73 (71.76)	312.55 (74.78)	1142.59 (77.43)
Other foodgrains	5.44 (3.70)	41.41 (8.72)	60.75 (13.94)	28.46 (6.81)	136.06 (9.22)
Total foodgrains	137.65 (93.60)	426.51 (39.81)	373.48 (85.70)	341.01 (81.59)	1278.65 (86.65)
Non-foodgrains					
Oil seeds	3.70 (2.52)	37.61 (7.92)	37.60 (8.63)	27.42 (6.56)	106.33 (7.20)
Vegetables	2.34 (1.59)	10.78 (2.27)	12.59 (2.89)	27.67 (6.56)	53.38 (3.62)
Fodder crops	2.87 (1.95)	-	6.80 (1.56)	2.80 (0.67)	12.47 (0.85)
Others	0.50 (0.34)	-	5.33 (1.22)	19.06 (4.56)	24.89 (1.68)
Total Non-foodgrains	9.41 (6.40)	48.39 (10.19)	62.32 (14.30)	76.95 (18.41)	197.07 (13.35)
Total (A + B)	147.06 (100.00)	474.90 (100.00)	435.80 (100.00)	417.96 (100.00)	1475.72 (100.00)

Note: Figures within brackets indicate percentages)

Cost of Inputs

Table 8 gives item wise cost of inputs per cultivated hectare in different size groups. The average cost of inputs per cultivated hectare works out to about Rs. 3916 and it varies from about Rs. 4517 on marginal farms to Rs. 3298 on large farms showing decreasing trend with increase in farm size. Human labour and machinery are almost equally important inputs on sample farms. Fertilizer, irrigation and seeds are the next important inputs. Use of vital inputs (fertilizer, irrigation and seeds) per hectare is the highest on small farms while use of machinery and hired labour is the highest on medium and large farms The large proportion of hired labour in medium and large farms may be a constraint due to high cash cost.

The above table shows that average yield per hectare of major crops is the highest (26.42 quintals) on small farms and lowest (23.42 quintals) on large farms. The use of better seeds, more fertilizers and also timely irrigation have resulted in higher crop yields on small farms. Inadequacy of resources may be a constraint for vital input use on large farms. The large proportion of use of hired labour in medium and large farms is clearly a constraint due to high cash cost. Thus low crop yield on large farms is mainly due to cash input constraint.

The large proportion of use of hired labour in medium and large farms is a constraint due to high cash cost.

Table 8 : Item-wise expenses incurred on the use of inputs (Rs. per cultivated hectares)

Crop	Marginal	Small	Medium	Large	All
Seed	353.26	449.89	354.82	243.41	345.74
	(7.82)	(10.05)	(9.13)	(7.38)	(8.83)
Fertilizer	671.28	833.52	632.31	478.58	644.21
	(14.86)	(18.62)	(16.27)	(14.51)	(16.46)
Irrigation	782.40	877.39	613.65	449.55	651.00
	(17.32)	(19.60)	(15.79)	(13.63)	(16.62)
Pesticides		4.03	2.33	1.32	2.32
		(0.09)	(0.06)	(0.04)	(0.06)
Machinery	991.56	1036.75	1155.02	1128.00	1097.36
	(21.95)	(23.16)	(29.72)	(34.20)	(28.02)
Bullock labour	64.15	81.93	2.33	2.64	31.36
	(1.42)	(1.83)	(0.06)	(0.08)	(0.80)
Human labour					
(i) Family labour	1412.13	793.23	324.12	176.46	502.07
	(31.26)	(17.72)	(8.34)	(5.35)	(12.82)
(ii) Hired labour	242.59	399.75	801.75	818.30	642.28
	(5.37)	(8.93)	(20.63)	(24.81)	(16.40)
Total (i + ii)	1654.72	1192.98	1125.87	994.76	1144.35
	(36.63)	(26.65)	(28.97)	(30.16)	(29.22)
All	4517.37	4476.49	3886.33	3298.26	3916.34
	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)

Note: Figures within brackets indicate percentages.

Crop yield

The average yield per hectare of selected crops in different categories of farms is given in table 9.

Table 9 : Average yield of selected crops

(quintals/hect.)

Crop	Marginal	Small	Medium	Large	All
Bajra	7.28	7.37	6.91	6.04	7.11
Wheat	28.01	33.85	30.43	27.89	30.32
Mustard	6.26	8.91	8.42	8.30	8.45
Moong	1.27	1.58	1.48	1.43	1.45
All	23.65	26.42	24.35	23.42	24.16

Farm Income

Table 10 gives the gross value of crop output, cost of inputs and net income per cultivated hectare on sample farms. The overall gross value of crop output per cultivated hectare is about Rs. 6302. Small farms have highest gross output per cultivated hectare (Rs. 7053) while large farms have the lowest (Rs. 5433). The overall net income is about Rs. 2386 per hactare. It is the highest (Rs. 2754) on small farms and the lowest (Rs. 2135) on large farms. This indicates that small farms are more productive compared to large farms. If we ignore the marginal farmers who have been provided tiny plots (34 out of 51 marginal farmers) under land distribution

programme and do not have other resources, inverse relationship exists between farm size and productivity.

Table 10 : Gross value of crop output, cost of inputs and net income per hectare by farm size (Rupees)

Category	Gross output	Input	Net Income
Marginal	7053.08	4517.37	2535.71
Small	7230.51	4476.49	2754.02
Medium	6381.62	3886.33	2495.29
Large	5432.96	3298.26	2134.70
All	6301.93	3916.34	2385.59

Output & Input

The crop yields, costs and income on owner cultivated land have been compared with tenant cultivated leased in land with fixed rent. Table 11 gives the average yield of selected crops grown on land operated on owned basis and land operated on tenancy basis.

Table 11: Average yield of selected crops (Quintals/hectare)

Category	Owned land		Leased-land	
	Bajra	Wheat	Bajra	Wheat
Marginal	7.05	27.69	7.66	28.27
Small	7.42	33.43	7.72	34.19
Medium	6.98	30.34	6.85	30.96
Large	6.33	28.27	5.21	27.18
All	6.98	29.94	7.29	32.84

Per hectare yield of bajra and wheat is higher on land operated on tenancy basis as compared with that operated on owned basis. This is due to the fact that over 86 per cent of the area operated on tenancy basis is under fixed kind rent system which induces greater use of modern inputs and thereby greater yield. This indicates that tenancy with fixed rent has no adverse effect on crop productivity.

Tenancy with fixed rent has no adverse effect on crop productivity.

Table 12 gives per hectare gross output, cost and net output on owned land and tenant land with fixed rent.

Per hectare cost of inputs is higher on tenant cultivated land. The greater use of inputs has resulted in higher gross output on tenant cultivated land as compared to owner cultivated land. But the net output is much lower (about Rs. 543) on tenant cultivated land in comparison with owner cultivated land (Rs. 2362). This is due to the fact that lessees taking land on lease had to pay fixed rent to the lesser. Category-wise marginal and small farmers have greater output per hectare in comparison to medium and large farmers. This is due to greater use of crucial inputs per hectare in the case of the former.

Table 12 : Per hectare input and output on owned land and leased in land (Rupees)

Category	Owned land			Leased-Land				
	Gross output	Cost of inputs	Net output	Gross output	Cost of inputs	Rent paid for leased in land	Total (col.6 + col.7)	Net output (col.6-col.8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Marginal	6964.83	4487.08	2476.75	7345.22	4571.87	2205.00	6776.87	568.35
Small	7035.46	4340.59	2694.87	7402.67	4569.94	2160.00	6729.94	672.72
Medium	6275.19	3696.91	2578.28	6510.05	4001.06	1980.00	5981.66	528.39
Large	5512.56	3416.43	2096.13	5097 .58	3209.73	1800.0	5009.73	87.85
All	6292.80	3930.60	2362.20	710 7.38	4395.62	2169.00	656 4.62	542.76

Conclusions

The following conclusions emerge from the foregoing discussion:

1. There exists a marked inequality in the distribution of cultivated land among the farming families in the village. Such a holding structure is not conducive to efficient land use, particularly in case of the marginal and the large farmers.

2. All farm resources (except farm workers) are concentrated on medium and large farms. The unequal distribution of land is the factor for concentration of farm resources on large farms.

All farm resources are concentrated on medium and large farms.

3. The extent of leasing-in land decreases with the increase in farm size. The leasing-in and leasing-out of land in case of marginal and small farmers is mostly confined within the same category. Of 17 marginal and small farmers leasing out their land, only one leased out land to a large farmer. This evidence belied the impression that those who lease-out are large farmers and those who lease-in are small farmers. A good part of the area leased-out belongs to absentee owners. The extent of leasing out land is much higher in case of scheduled caste families as compared to non-scheduled caste families. This is due to the fact that most of the scheduled caste families fall in the category of marginal farmers who have been provided tiny lots under land redistribution programme. They do not have any farm asset for self cultivation. Thus distribution of surplus land to the landless families will hardly serve any purpose if necessary farm resources are not made available.

4. The overall average intensity of cropping works out to about 163 per cent and it varies from about 193 per cent on small farms to about 140 per cent on large farms.

5. Of the total cropped area, about 87 per cent is under foodgrain crops—varying from 93 per cent in marginal category to 78 per cent in large category; and about 13 per cent area is under non-foodgrain crops—varying from about 6 per cent in marginal category to about 22 per cent in large category. Among foodgrain crops, major cereals account for as much as 73 per cent of total cropped area—varying from 84 per cent in marginal category to about 67 per cent in large category. This shows that the proportion of area under foodgrain crops decreases with increase in farm size while it increases with the farm size in case of non-foodgrain crops.

6. Of the total output, about 87 per cent is contributed by food-grain crops—varying from about 94 per cent in marginal category to 82 per cent in large category; and about 13 per cent is contributed by non-foodgrain crops—varying from about 6 per cent in marginal category to 18 per cent in large category. Thus the proportion of contribution by foodgrain crops to total output decreases with the increase in farm size while it increases with the farm size in case of non foodgrain crops. Among foodgrain crops, cereals account for about 77 per cent of total output and it varies from about 90 per cent in marginal category to about 75 per cent in large category showing decreasing trend with increase in farm size. Among non-foodgrain crops, oil seeds contribute about 7 per cent of the total ouput which is maximum and it varies from about 2 per cent in marginal category to about 9 per cent in medium category.

7. The average cost of inputs per hectare works out to about Rs. 3916 and it varies from about Rs. 4517 on marginal farms to Rs. 3298 on large farms showing decreasing trend with increase in farm size. Human labour and machinery are almost equally important inputs on sample farms. The fertilizer, irrigation and seed are the next important inputs. Use of vital inputs (fertilizer, irrigation and seeds) per hectare is the highest on small size farms while use of machinery and hired labour is the highest on medium and large farms. The large proportion of hired labour in medium and large farms may be a constraint due to high cash cost.

Use of vital inputs (fertilizer, irrigation and seeds) per hectare is the highest on small size farms while use of machinery and hired labour is the highest on medium and large farms.

8. The average yield per hectare of major crops is the highest on small farms and lowest on large farms. Inadequacy of resources may be a constraint for vital inputs on large farms. The lack of interest, poor managerial capacity and lack of direct participation in agricultural operations by the higher caste farmers are other reasons for low production per hectare. The higher crop yield on small farms is because of various supportive measures i.e. credit, input and extension taken by our government to benefit the small farmers.

9. The overall gross value of crop output per hectare is about Rs. 6302; it being highest on small farms (Rs. 7053) and lowest (Rs. 5433) on large farms. The overall net income is Rs. 2386 per hectare; it being highest (Rs. 2754) on small farms and lowest (Rs. 2135) on large farms.

Thus, it may be concluded that productivity of land and total output can be increased if the structure of land ownership is altered and a more even distribution is ensured. There is need to gear the supportive institutions to the requirements of the small farmers.

Reference

S. Gangadharan, 'Post Green Revolution Output—Illusion and Reality', The Economic Times, July 10, 1986.

□

Here is a six-step general formula that fits any case in which no clear-cut right or wrong exists:

1. Forget hunches and prejudices.
2. Study carefully the facts that are available.
3. Determine what might be the best result and the worst result from each possible choice.
4. Consider whether you could bear the worst possible result in each instance without disastrous effects.
5. If so, decide whether the best possible result is likely enough and inviting enough to warrant risking the consequences of failure.
6. Select the course that offers the brightest prospect *in proportion to its risk.*

Source : Charles A Carami : How to Solve Management Problems, Englewood, Prentice Hall

Crosby on Completeness

Philip B. Crosby gained ıame in the 1960s with his concept of Zero defects. Author of ***Cutting the Cost of Quality, The Art of Getting your Own Sweet Way, Quality is Free, Quality Without Tears, Running Things, The Eternally Successful Organisation, Let's Talk Quality and Leading: the Art of Becoming an Executive,*** *he recently published his book on* ***Completeness: The Quality for 21st Century.*** *Written with considerable depth of thought, completeness is philosophical and mission bound. The mission is completeness and a more thorough way to express his belief in zero defects and ccnformance to requirements.*

Ajit Singh, our former Director (TQM) interviews Crosby on his new book ***'Completeness'.***

Why do you profess quality for 21st Century? Will quality be different then than what it is today?

Managing quality will be different in that those companies who cannot produce without the costs and disruptions that accompany error will not survive. World competition will require taking prevention seriously. Very few do that today. Typical companies spend 25% of revenue, and more, because they have not learned to do things properly. That will not let them grow in the new environment.

Will the concept 'completeness' not create confusion in the minds of readers, as TQM has become familiar the world over? Will it not be treated as a new jargon without being taken seriously?

Readers mostly do not understand what quality really is. TQM is just a rework programme, all the efforts are to fix problems by the use of tools and techniques. Nothing is done to change the culture that produced the problems in the first place. Quality management requires that the culture of the company be changed. Completeness is an effort to encourage executives to broaden their understanding of cause and result.

How would you differentiate between the executive of today and the Centurion?

The Centurion will be much smarter about managing than current executives. Most of today's executives know very little about the rest of the world and its history. They are not consistent in their policies and purpose. Few companies make a good return on investment because of that.

You have described 'completeness' as "Systems making up the organisation considered as a whole, and nothing taken for granted". Is this not what is being talked for several years in Organisation Development, Strategic Management and also in TQM? Your comments?

The concept of current management systems is modular, the company is managed as a group of functions rather than as a living organism. TQM is fantasy with no

reality in it; that is why people are disappointed with the results of TQM. I an hoping to lead the way to an end of the search for the mythical "silver bullet" that will save companies. There is none, only knowledge and hard work.

You have said that "we have high paid, professionally driven ownership oriented employees who want things to come to them correctly; we have customers thousands of miles away....." But how to turn such incredible complexities into solution? How to meet this challenge?

Quality management is not difficult but it is a culture not a technique. The content of quality management is: Management Commitment (which means taking personal charge of the integrity of the company); Education (which means that every individual must understand the concepts of prevention and their role in making it routine); Corrective Action (eliminating problems forever, much of TQM is aimed at finding and fixing problems but not much on prevention) ; and completeness (which refers to the continuing wellness oriented lifestyle of the organisation).

You say quality should be the fabric of the organisation. You did not discuss in the book the processes to achieve it.

I wrote about making quality the "fabric" of the organisation in the book *Leading: The Art of Becoming an Executive.* Management should be concerned with Finance, Quality and Relationships. Finance is nourishment, quality is fabric, and relationships are the soul. The responsibility for causing this to happen cannot be delegated. My books *Quality without Tears, Quality is Free* and the *Eternally Successful Organization* discuss all this in detail and include case histories. They show the reader how to understand what must be done.

The purpose of completeness is to avoid problems and guarantee success. Can you explain in brief how to cause:
Employees to be successful?
Suppliers to be successful?
Customers to be successful?

Employees, suppliers and customers become successful when they are accomplishing what is important to them. The book goes into great detail on this. But basically they need to be given the opportunity to receive what they need and have the opportunity to contribute. People need to live, not just exist. Suppliers need to have "co-prosperity"—customers need to have their requirements met each and every time. 'Satisfied" is much less than 'successful".

You stressed communication as an important factor in the life of the Centurion. Communication is important today as it will be in the 21st century. Communication is a keyword even in TQM. Your views?

Communication is a word that means different things to different people. In the 20th century it has not necessarily referred to assuring that everyone knew what was happening and why. Groups were blocked out or limited. Now much information comes up from the bottom of the organization rather than floating down from the top. Communication cannot be left to chance.

The course coverage proposed by you on management education does not differ very much from any other management course except that completeness replaces quality or productivity etc. In what way the management education will be different is not clear. You may like to clarify?

I know of no management courses which concentrate on the whole body of the company, they deal with arms and legs. For that reason, managers develop tunnel vision. There is a great deal of difference between this and completeness.

You mentioned that there are five things you can do to provide a foundation for completeness in personal life:

1. *Love God*
2. *Love your fellow creatures*
3. *Keep learning*
4. *Set goals*
5. *Be happy*

These are universal principles for a good personal life and not much to do directly with quality in 21st century. In India, they all exist in our epics and all our books and yet the quality is not very impressive. Your comments?

The five things are my personal recipe for personal success. Quality of life comes from individuals, not from organisations. The only way the world will ever learn how to get along with each other is on an individual basis. Governments and companies have no motivation along that line. It has everything to do with quality. In the past 3200 years there have been less than 250 years without a war going on.

For the first several thousand years of recorded history, management was mostly a matter of dealing with people and animals as they performed low level labour. You again say that we may well be back to managing people who are coping with a technology in 21st century. Is there not some inconsistency in your statement? Managing people was, is and will remain an important function. Your comments?

Managing people changes when the people's minds are the asset rather than their strong backs or quick hands. Knowledge workers must be led and educated rather than controlled and driven. Projects and jobs will be managed; people will have to be led.

The organisation tends to become completely flat when you say "The top of the organisation chart is going to be dealing directly with the bottom." How?

What is now known as middle management and first level supervision will disappear as we enter the new age. People do not need all that direction. They need education and training and freedom to work in their own way. The senior management will have to provide direction and policy as well as keep close touch with the people to help them be successful. Those non productive areas of supervision will no longer be needed.

Continuous quality improvement is the basis of Japanese success. 'Kaizen' which means small improvements accumulated to give higher productivity and quality has been the basis for improvements in Japan. You have mentioned that " we need to leapfrog, not fight our way out of the bush". How to do it with respect to quality?

Quality, in management terms, is having a policy that says " we will learn to do things right the first time" and education based on learning to prevent problems, and the example of leadership to create an organisation that gets better all the time. Right now the TQM and other movements have mired quality management in techniques and tools oriented toward repair of the existing process. We need to break away from that and create a new, prevention oriented culture in the company. " Kaizen" is just one more programme that takes time away from working hard and smart.

We must realize that there are no magic pills or fairy dust that can be applied to an organization and guarantee success. Management must study and learn many things and take the actions that are best for their company. The purpose of the Completeness book is to expose readers to some things they may not have thought about. It is not to provide a program or key word that will carry them through to being wonderful without working or thinking hard.

Form IV

Statement about Ownership and Other Particulars about Newspaper Productivity

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I, S. Ray, hereby declare that the particulars given above are true to the best of my knowledge and belief.

Date : 28-2-93

S/d
(S. Ray)
(Signature of Publisher)

Thermal Power Sector

S.A. Subramanian

Thermal power has been the mainstay of the energy sector in India constituting about 70 per cent of the total installed power capacity. The efficiency of the sector merits a detailed review. This study presents a merit list in the order of their level of efficiencies of some 45 thermal power stations. The role of combined cycle gas turbine power plants utilising natural gas is also examined.

S.A. Subramanian is a former member of the Central Electricity Authority (CEA). *This study has been supported by the National Productivity Council.*

Thermal power stations constitute 70 per cent of the total installed power capacity in India. While there could be a question as to whether the ratio of thermal to hydro power should be of this order of magnitude, there would be no debate that the installed capacity should be put to best use. Considerable emphasis has therefore, been laid on plant utilisation factor known as PLF. There is also a need to consider the overall efficiency of the sector. The basic input being fossil fuel whose costs are rising steeply (to as high as Rs. 1000, per tonne in Tamil Nadu), there is an urgent need to improve the plant efficiencies and derive the maximum possible benefit from a given quantum of fuel. If 1 per cent saving is achieved on the fuel front, it would be equivalent to about one million tonnes of coal, thereby reducing the fuel cost per kilowatt hour, apart from savings in other areas. This paper brings out a merit list in the order of efficiencies of 45 thermal power stations based on the data available from the latest annual operation science or the Central Electricity Authority for the year 1990-91. The role of combined cycle gas turbine power plants utilising natural gas is also examined. Even though the manpower employed in thermal stations is not large, output per man has also been dealt with in this study in terms of generation in million Kwhr/man/year.

Coal Quality

In many of our thermal plants, the coal received deviates from design values especially in calorific value. In 1965, a general policy decision was taken by the Govt. of India that the more distant a power plant is from the coal source, the better should be its coal quality. There are instances where a power plant designed to burn coal of gross calorific value of 4800 Kcal/kg. receives coal of below 4000 Kcal/kg. The far flung power stations in Tamil Nadu receive coal of much inferior quality compared to many plants with lesser haulage distances. The main consequences of such quality deviations are that the specific coal con-

sumption becomes higher and the auxiliary consumption rises in as much as the quantities handled in the coal handling system, milling (pulverising) plant, ash handling plant, etc. increase. For example, the pulverizers typically consume about 15 to 20 Kwh/tonne ground. Increased coal consumption proportionally increases the mill power consumption. If coal calorific value is 3500 Kcal/kg as against a design quality of 4500 Kcal/kg, the coal quantity handled increases approximately by 28 per cent causing proportionate rise in pulveriser power consumption. The efficiency of boiler is adversely affected by the moisture content. So long as exit gas temperatures and unburnt carbon losses are maintained, a decrease in coal quality should not cause a decrease in boiler efficiency, except when mill performance declines.

Some of the old units (like the non-reheat 100 MW units) underwent boiler modifications leading to lesser absorption in economizer because of which the exit gas temperatures rose by 30° to 50°C. Such a rise reduces the boiler efficiency by 3 to 4 per cent, the higher percentage difference being for the lower GCV of coal.

However, where the coal quality is very different from design, the plant may not be able to generate its rated output. Such a limitation will adversely affect the plant performance by increasing the heat consumption per KWh generated and sent out. A power plant in Madhya Pradesh went through such a history involving loss of output in their 200 MW units requiring the installation of an additional pulverizing plant with separate burner (known as DIPSY) to lift additional load. Incidentally this additional installation also served to achieve a lower oil consumption during low load and other operational exigencies.

There are also some power plants which get coal of higher calorific values than designed but with lower volatile content leading to higher secondary oil consumption. In theory, with pulverized coal burning, the boilers should respond to a slight drop in volatile content without loss of stability but the operator would not take the risk of instability of flame especially under varying load conditions.

There is an important coal parameter described as Hardgrove Grindability Index (HGI) whose reduction causes an adverse effect on pulverizer output. But in some situations while the GCV of coal is lower, the HGI is higher, thereby enabling the mills to handle higher throughput. Thus, while in general a decline in GCV has quite a number of disadvantages in operation, one has to weigh all parameters to evaluate the effect on unit output.

While in general a decline in GCV has quite a number of disadvantages in operation, one has to weigh all parameters to evaluate the effect on unit output.

Moisture Content

Most thermal plants suffer reduction in generation in the rainy season as the coal gets saturated with moisture and wet coal causes flow problems in chutes and transfer points. Higher moisture content reduces pulveriser output. This necessitates extensive use of oil support apart from an increase in heat consumption due to lower load operation. In many cases, the total moisture increases by over 4 per cent under saturated conditions. Apart from the problems in coal flow which affect output, the boiler efficiency also decreases because of increased moisture. Conventional pulverized coal fired boilers suffer stability problems when the total inerts increase to about 70 per cent. Thus the total of ash plus moisture plays a significant role. However, such high limit of inerts is not usually reached in our power plants except in case of rejects from washeries. The lignites which are a less mature form of coal do have a higher moisture content with values over 50 per cent in Neyveli and Kutch. But the total inerts in such cases are below 70 per cent. Problems of stable ignition arise with higher moisture brown coals such as in Australia where for every kilogram of coaly matter, there are two kilograms of water. In such cases, special schemes are adopted to separate the highly inert water vapour as it emerges from the milling plant. Prior to such a scheme being adopted, serious instability in furnace was experienced. In our power plants, the total moisture could be about 22 per cent to 25 per cent in the rainy season. The milling plant should be capable of dealing with such occurrences so that the unit output does not decrease.

Ash Content

The highest ash content was first encountered in the sixties in the 90 MW Korba power plant of Madhya Pradesh. But so long as adequate capacity existed, there was no significant loss of output as that power station has a steam range system with adequate ca-

pacity, even though the margins were reduced. Ever since, many other plants have faced high ash presence which results in lower calorific values and ample milling and handling capacities have to be provided. We have learnt the importance of lower flue gas velocities to minimize erosion. It has also emerged that the designers had not totally grasped the effect of high particulate presence on heat transfer and the estimated values of gas temperatures were at variance with actuals, very often leading to higher exit temperatures with consequent higher boiler losses necessitating increased quantities of attemperation. In a number of reheat boilers, the main steam temperature had to be kept down to maintain the reheated steam temperature which adversely affected efficiencies. Further, what was initially conceived as emergency attemperation for reheat steam became a routine necessity with consequent drop in efficiency. A number of power plants are facing such mismatch problems. There was also a tendency for furnace fouling at higher loads not only in the case of bituminous coal fired boilers but in lignite fired boilers too. In general, the manufacturers have been drawing a number of lessons from the experiences which even overseas collaborators could not fully foresee.

The manufacturers have been drawing a number of lessons from the experiences which even overseas collaborators could not fully foresee.

Boiler Efficiency

Large boilers are designed for efficiencies of the order of 88 per cent with our coals. But maintaining the efficiencies in normal operating conditions involves keeping the surfaces—both internal and external, clean, appropriate control of leakage air etc. Sootblowing and absolute adherence to water chemistry norms are called for. One of the main criteria for an operator should be the exit gas temperatures. Boiler efficiency tends to peak at an optimum output and drops at lower and higher outputs. Thus forcing the boiler could lead to lower efficiencies. Such a situation should not normally arise except when the units are operated at very adverse conditions, like poor condenser vacuum etc.

Natural gas firing usually suffers from lower boiler efficiencies, though there would be a saving in auxiliary power as there is no need for crushers or pulversers. A few installations like Trombay use gas in boilers. The mainstay for this power station as well as Dhuvaran in Gujarat is oil firing which leads to better boiler efficiency, 90 per cent. In the case of Trombay, limitations on coal firing are because of environmental criteria. The oil used is mostly LSHS which has a lower sulphur content. Barring these two cases and 2×30 MW units in Assam, no other power plant is designed to burn oil as a primary fuel in its boilers. Table 1 presents the overall efficiency of 45 power stations. The GCV of those stations varied from 3083 Kcal/kg to 5386 Kcal/kg (A.E.Co.). The average GCV of lignite at the Neyveli Power Station I was 2391 Kcal/kg and at the Neyveli Power Station II, it was 2334 Kcal/kg. Whereas the all India average specific coal consumption was 0.72 Kg/Kwh, the specific lignite consumption at NLC I was 1.45 Kg/Kwh and NLC II was 1.09 Kg/Kwh.

Plant Load Factor

The dire need to have high levels of generation led to great emphasis on maintaining the Kilowatt/hours. With the system of giving meritorious awards based on plant load factor, power plants vied with each other to bring up the PLF, and bridge the growing gap between demand and supply of electricity. However, it is necessary to focus equal attention on efficiency of the units which is brought out in the heat rate in kilocalories per kilowatt/hour sent out. This heat rate would cover the secondary oil consumption and the auxiliary consumption.

Heat Rate Factor

Usually at given steam conditions, the TG heat rates tend to decrease with increase in output except when overloading is done at higher outputs. The auxiliary consumption as a percentage decreases with increased generation. In large units such as 500 MW where the boiler feed pumps are integrated in the heat cycle by using steam turbine drives, the electrical output could be higher. In general, larger units have lower auxiliary power consumption as a percentage of unit output. However, in comparing heat rates, one should keep in view the nature of drive of auxiliaries like feed pump. The heat rates of such units are expressed separately to exclude feed pumps if they are steam drive, so that one can make an equitable comparison with a unit with electrical feed pumps. For example, the feed pumps of a 500 MW could consume about 3 to 4 per cent of unit output. Typically with the sub-critical parameters adopted in India, the motor of a 50 per cent capacity

Table 1 : Overall Efficiency

POWER STATION	INSTA-LLATION CAPA-ACITY MW.	GROSS GE-NERATION 90 - 91 IN MILLION KWHR	GROSS GCV OF COAL KCAL/ KG.	HEAT RATE KCAL/KWHR GENE-RATED	SECON-DARY OIL CON-SUMPTION ML/KWHR	AUXILIARY CONSUMP-TION %AGE	HEAT RATE ON UNIT SENT OUT BASIS	OVERALL EFFI-CIENCY	P.L.F	AVAILA-BILITY FACTOR %	AVAILA-BILITY FACTOR (NETT) %
KORBA S.T.P.S	2100	11547	3408	2375	2.43	7.29	2561	33.58	62.8	79.5	65.1
KORBA WEST	840	5065	3452	2429	3.66	9.38	2721	31.61	68.8	83.5	68.5
TROMBAY	1330	5771		2661	-	5.46	2760	31.16	49.5	81.4	56.2
TURICORIN	630	3939	3978	2521	3.38	8.11	2780	30.94	71.4	77.1	71.7
METTUR	840	3046	3083	2537	5.4	9.39	2853	30.14	41.4	63.6	56.9
NEYVELI II	630	3600	2334 (LIGNITE)	2551	2.7	9.69	2855	30.12	65.2	75.5	65.7
SINGRAULI S.T.P.S.	2000	12339	4668	2634	0.67	7.84	2865	30.02	70.4	85.1	70.6
ROPAR	840	3764	4004	2629	4.75	7.26	2886	29.8	51.1	77.3	73.01
UKAI	850	4647	4763	2627	3.11	8.81	2914	29.51	62.4	76.8	66.2
RAICHUR	420	2802	3681	2760	1.06	7.81	3006	28.61	76.2	87.9	76.2
BANDEL	530	1824	14747	2785	14.07	9.3	3226	26.66	39.3	68.7	42.6
RAMAGUNDAM S.T.P.S.	1600	7268	4022	2876	4.59	10.02	3246	26.49	51.8	69	51.8
TITAGARH	240	1553	4605	2802	12.9	9.84	3251	26.45	73.9	92.3	73.2
FARAKKA	630	2952	3312	2862	5.25	10.41	3253	26.44	53.5	74.9	54.6
WANAKBORI	1260	5885	4488	2888	10.56	9.66	3306	26.01	53.3	68.3	56.9
KOTA	640	2398	4390	2790	14.94	11.68	3328	25.84	42.8	54	43.6
KORADI	1080	5714	3829	2942	6.0	10.12	3340	25.75	60.4	77.3	61
VIJAYAWADA	630	4627	4186	3046	2.69	8.63	3363	25.57	83.8	89.3	85.44
BHATINDA	440	2174	4119	2979	2.74	11.12	3382	25.43	56.4	84.5	73.1
SIKKA (RE-PLACEMENT)	120	485	4531	2926	11.67	10.29	3392	25.35	46.1	81.96	46.11
VINDHYACHAL S.T.P.S.	840	4229	4237	2985	7.29	10.23	3406	25.25	57.5	76.09	61.64
ENNORE	450	2009	3290	3018	4.43	10.03	3403	25.27	51	67.29	51.19
PAPLI	690	2726	3918	2920	11.65	11.18	3419	25.15	45.1	63.88	47.54
BHUSAWAL	480	3105	4232	3062	4.6	9.67	3441	24.99	73.9	85.9	74.93
AHMEDABAD	434	2441	5386	3124	3.36	9.67	3495	24.61	64.22		
OBRA	1482	8232	4118	3128	3.34	10.93	3598	23.9	63.4	74.76	63.41
KOLAGHAT	630	2198	4424	3200	12.33	8.25	3622	23.74	39.83	82.13	**57.7
SATPURA	1142	4153	3475	2847	26.83	11.35	3626	23.72	41.5	67.85	41.59
CHANDERPUR DVC	780	1914	4022	3013	36.16	8.63	3694	23.28	28.02	53.78	28.1
GANDHINAGA	450	1437	5063	3247	8.92	10.42	3724	23.09	36.5	75.78	60.25
AMARKANTAK	300	1004	4063	3229	15.91	10.01	3765	22.84	38.21	58.46	38.21
PARAS	80	281	4136	3335	10.19	8.88	3772	22.8	40.17	61.46	45.92
SANTALDIH	480	911	4939	3209	6.23	13.33	3775	22.78	21.7	36.26	21.8
NEYVELI I	590	3861	2391	3458	2.7	8.57	3812	22.56	74.7	81.52	74.83
NASIK	910	4670	4785	3470	7.8	8.83	3892	22.10	58.59	78.42	51.04
DURGAPUR DPL	390	832	4369	3277	29.81	10.56	3896	22.07	24.35	41.77	24.8
KORBA EAST	400	2151	3616	3439	8.9	10.13	3926	21.9	61.39		
TALCHER	460	1368	3928	3416	8.35	10.89	3928	21.89	33.92	53.32	34.1
DURGAPUR D.V.C.	350	1052	4595	3406	25.6	10.16	4076	21.1	34.3	63.02	34.67
ANPARA - A	630	3742	4316	3625	2.16	11.09	4102	20.97	67.8	80.54	68.34
KATHAGUDAM	670	2942	4100	3621	5.36	11.08	4132	20.81	50.12	68.74	49.93
I.P.STATI	277.5	1399	4918	3424	26.34	11.02	4144	20.75	57.55	77.76	57.88
BADARPUR	705	4148	4186	3519	6.02	13.88	4156	20.69	67.16	88.96	71.76
PANKI	242	617	4530	4229	13.1	13.84	4538	20.34	29.12	44.68	29.11
CHANDRAPUR MSEB	840	4239	4592	4358	4.21	10.83	4592	19.73	57.6	75.3	59.45

feed pump of a 500 MW unit could be of 12000 KW rating, two such pumps being in operation at full load with a standby feed pump. The auxiliary consumption of the two 500 MW units in India with such electrical feed pumps is about 9 per cent if the boilers are coal fired. The guaranteed heat rate at 500 MW is 1920 Kcal/Kwh with electrical feed pumps. The auxiliary consumption of the 500 MW units which have two 50 per cent capacity steam turbine driven feed pumps is about 6 per cent and the guaranteed heat rate is about 1980 KCal/Kwh including feed pumps. Where the cooling water for condensers of the main turbine goes through cooling towers, the auxiliary consumption could be higher by about 0.3 to 0.4 per cent.Thus steam driven feed pumps are advantageous. The steam generators should have adequate capacity to cater to the requirements with steam driven feed pumps.

The larger units of 500 MW are designed for higher steam conditions of 170 at 538°C/538°C. The turbines in India made by the public sector manufacturer to German design are of throttling type where the advantage lies in operating at MCR. At part loads, the throttling losses rise. But to compensate for it, manufacturers usually recommend lower steam pressures which reduce the losses. The vacuum at the turbine exhaust maintains efficient operation with other factors like the unit output, corresponding temperature rise across the condenser, and the exhaust hood temperature.

Operational Parameters

An idea of operational parameters can be had from certain spot readings on some 500 MW units given in table 2.

Table 2 :Spot Readings on some 500 MW units

Unit output in MW	500	480	425	404	380	350
Steam pressure at TSV kg/cm sq	170		168		160	
Steam temp at TSV °C	532		535		537	
Reheat steam temp °C	535				537	
Steam flow T/hr.	1440				1125	
F.W. flow T/hr	1460					
C.W. inlet to condenser °C	25	35	28	35	34	27.5
C.W.outlet from condenser °C	38	46	39.5	45	44	37.5
Exhaust hood temp°C	44	50	50.7	50	48	
Back pressure/Vac	70 mmHg	112 mmHg	103 mmHg	102 mmHg	107 mmHg	75 mmHg

The readings relate to different units and at different points of time. As these are based on panel/site instruments, there could be some inaccuracies in the values. A number of our largest sized machines are operating at part loads involving loss of efficiency and quite a few sets are not maintaining target vacua.

Condensers are static equipment and are surface type heat exchangers. Many power plants are able to maintain the temperature rise through them and the target vacua. Others suffer from inability to maintain such vacua. Some condensers suffer from clogging of tube sheets. Some are prone to have deposit formation in the water tubes. In consequence, the CW quantity is affected thereby causing high temperature rise, terminal differences and high back pressures. Where CW is known to contain debris, it is worthwhile having debris fillers. To keep the internal tube surfaces clean, rubber ball cleaning equipment needs to be used. Emphasis on this system will pay good dividends as otherwise the heat consumption rise could be comparatively high. The non adherence to inlet steam conditions causes much lower increase in heat consumption than rise in back pressures.

The non adherence to inlet steam conditions causes much lower increase in heat consumption than rise in back pressures.

Operation at part loads would lead to lower efficiencies. For example, a 500 MW TG set with a guaranteed heat rate of 1986 Kcal/Kwh at full load, gives a heat rate of 2021 Kcal/Kwh at 400 MW and 2080 Kcal/Kwh at 300 MW, the rise in heat consumption being 1.76 per cent and 4.73 per cent respectively. In actual practice , the difference in heat rate is higher. For example, in a case at 60 per cent operation it was 5.3 per cent higher.

Some 500 MW sets are able to maintain guaranteed heat rates years after first synchronizing due to adherence to specified parameters. In a machine, tested two years after commissioning, the tested heat rate was 1984.9 Kcal/Kwh against a guaranteed value of 1985.7 Kcal/Kwh. In another case, a 500 MW unit with electrical feed pumps gave a test value of 1909 Kcal/Kwh against a guaranteed value of 1913 Kcal/Kwh, the test having been done some 8 years after first commissioning. Incidentally the boiler of this unit gave under test condition an efficiency of 88.6 per cent with coal of

GCV 5125 Kcal/kg, the gas exit temperature being 140°C.

The target vacuum with one 500 MW unit with a C.W.inlet temp. to condenser at 28°C was 65 mm Hg whereas even at part loads, the machine had a much higher back pressure, of the order of 100 mmHg. For a pressure rise from 0.0884 ata to 0.12 ata, the heat consumption rise is about 1.5 per cent. In some cases, the prevalent back pressures were beyond the range of correction curves.

Reasons for Boiler Inefficiency

Typical spot readings on some 200/210 MW units are furnished in table 3 . The same remarks regarding accuracies apply here as mentioned for the spot readings relating to 500 MW units. Units at 1,2 and 7 are for a basic steam pressure of 130 ata at TSV, the rest are 150 ata units.

Many of the units covered above suffer from high back pressures, leading to higher heat consumption rates. In a case, the manufacturer of a TG set designed for TSV conditions 130 ata 535°C/535°C, stipulated a rise of TG heat rate by 20 Kcal/Kwh for a rise of back pressure by 0.02 ata over the design value of 0.089 ata, the guaranteed heat rate being 2018 Kcal/Kwh at MCR of 210 MW. In the same case, a rise of heat rate to 2035 Kcal/Kwh was mentioned for unit operation at 80 per cent MCR and to 2089 Kcal/Kwh at 60 per cent MCR.

In a typical 210 MW TG set designed for 150 ata steam pressure, the guaranteed heat rate with steam conditions of 150 ata 535°C/535°C, CW inlet temp. of 33°C to condenser, the back pressure being 0.1033 ata and zero make up, was 1980 Kcal/Kwh. The TG heat rate, however, rises by 2.52 per cent at 80 per cent MCR and by 6.25 per cent at 60 per cent MCR. The penalty on TG heat rate for operation at part loads is brought out. Another important factor contributing to loss of efficiency is increased make up to boiler turbine cycle. In a 200 MW set, the unit heat rate rises by 0.5 per cent for one percent increase in makeup. A number of units have trouble with feed heaters. In a case, the manufacturer stipulated an increase in heat consumption by 3.72 per cent for operation at full load without HP heaters. In some cases the makers propose a reduction in output when HP heaters are out.

As regards boiler efficiencies, a test on a 200 MW boiler gave an efficiency of 83.6 per cent with a coal of GCV 3721 kcal/kg. This test was done some 7 years after first commissioning.

An indication of the nature of penalties on efficiency involved in unit operation at variance from prescribed parameters is derived from the previous sections. Many units have condenser pressures higher than design values and therefore incur heat rate penalties of a high order. Many units also have high make up and quite a number operate without HP feed heaters. Added to these, part load operation aggravates the inefficiencies. During performance tests, a

Many units have condenser pressures higher than design values and therefore incur heat rate penalties of a high order. Many units also have high make up and quite a number operate without HP feed heaters.

Table 3 : Spot Readings on some 200/210 MW Units

Unit output in MW	208	190	208	207	200	170	180	165
Steam pressure at TSV kg/sq cm	130	125	150	150	146	145		
Steam temp at TSV °C	532	535	530	535	529	534		
Reheat steam temp. °C		528	525		513	527/537		
Steam flow T/hr.	651							
F.W. temp. at boiler °C	242		208		197	233	240	
C.W.at Cond. inlet °C	30	28	30	32	29	35	33	34
C.W at Cond. outlet °C	41	36	40	42	39	44.5	42	43.5
Exhaust hood °C	45	46	50		49.5		70	55
Back pressure/vac	0.125 ata	55 mmHg		680 mmHg	80 mmHg	111 mmHg	590	
Flue gas boiler exit °C							138	

manufacturer is permitted to readjust clearances and usually thorough cleaning is done especially in the boilers and heat exchangers. Hence in actual practice, the efficiencies obtaining in day to day operation would be lower than when conducting a contractual performance test.

Economic Criteria

Aspects relating to costs have a bearing on operation. For example, a 600 MW plant costing about Rs.1200 per KW installed in the sixties would have completed its originally planned operating life time. The fixed charges on such a plant would be a few paise per Kwh while the fuel charges could be about twenty times the fixed charges. Such old stations could be reserved for assistance in peaking. On the other hand, a recently installed power plant costing about Rs. 10,000 per KW would have fixed charges of say 15 per cent. Then the fixed cost per Kwh would be quite high with a low generation. For example, if we generate 4000 Kwh/Kw. then the fixed cost would be 37.5 paise per Kwh whereas if we generate 5000 Kwh/Kw, the same will come down to 30 paise per Kwh. And fuel costs in this case are a lesser multiple of fixed charges. For example, with Rs. 700 per tonne of coal and a specific coal consumption of 0.7 kg/Kwh, the fuel cost will be 49 paise/Kwh generated. Thus the total rough cost/kwh generated would be, with 4000 Kwh/Kw,86.5 paise/Kwh. This is the logic in aiming for maximum generation. Table 4 gives the plant load factors for various power plants. The Kwh/Kw for Vijayawada is 7344 and that at Santhaldih 1898 Kwh/Kw. The capital costs have varied from about Rs. 1000/KW at Bokaro, installed four decades ago, about Rs.1200 at the Neyveli I (sixties). Rs. 3000 at Badarpur (seventies) to about Rs. 18000 at Rihand (late eighties). The coal costs/fuel costs have also risen with time. It was less than Rs. 100 a tonne in Delhi in the fifties whereas it is about Rs. 7000/tonne now. The coal cost at so called pit heads with inferior grades like at Korba is about Rs. 250/tonne and at the TNEB power plants, it is Rs. 1000/tonne. Now coal price being such that the best quality of coal at Singrauli area costs about Rs. 500/tonne whereas in the Korba regions it is about Rs. 250/tonne, the emphasis on higher efficiency is of paramount importance.

The Korba STPS has the best efficiency per unit sent out (33 per cent) with the others being lower. The efficiency brings out the productivity in terms of utilization of energy in fuel. We have stayed subcritical in

Table 4 : Overall PLF

POWER STATION	OVERALL PLF	KWHR GENERATED/ KW CAPACITY	KWHR SENT OUT PER KW CAPACITY
VIJAYAWADA	83.8	7344	6710
RAICHUR	76.5	6671	6150
NEYVELI 1	74.7	6544	5983
TITAGARH	73.9	6471	5834
BHUSAWAL	73.9	6469	5843
TUTICORIN	71.4	6252	5745
SINGRAULI	71.4	6169	5685
KORBA WEST	68.8	6030	5464
ANPARA-A	67.8	5940	5281
BADARPUR	67.2	5884	5067
NEYVELI II	65.2	5714	5160
A E & CO.	64.2	5624	5080
OBRA	63.4	5555	4948
KORBA STPS	62.8	5499	5098
UKAI	62.4	5467	4985
KORBA EAST	61.4	5378	4831
KORADI	60.4	5291	4755
NASIK	58.6	5132	4679
VINDHYACHAL	57.5	5035	4519
CHANDRAPU MSEB	57.6	5046	4499
I.P. STATION	57.6	5041	4486
BHATINDA	56.4	4941	4391
FARAKKA	53.5	4686	4198
WANAKBOR	53.3	4671	4229
RAMAGUNDAM	51.8	4542	4087
ROPAR	51.1	4481	4156
ENNORE	51.0	4464	4017
KOTHAGUDAM	50.1	4391	3904
TROMBAY	49.5	4339	4102
SIKKA (R)	46.1	4042	3904
PARLI	45.1	3951	3509
KOTA	42.8	3747	3309
SATPURA	41.5	3637	3224
METTUR	41.4	3626	3286
PARAS	40.2	3512	3201
KOLAGHAT	39.8	3489	3201
BANDEL	39.3	3441	3121
AMARKANTAK	38.2	3347	3012
GANDHINAGA	36.5	3193	2861
DURGAPUR DVC	34.3	3006	2700
TALCHER	33.9	2974	2650
PANKI	29.1	2550	2197
CHANDRAPUR DVC	28.0	2454	2242
DURGAPUR DPL	24.4	2133	1908
SANTHALDIH	21.7	1898	1645

steam pressures and the gain in TG heat consumption between the best subcritical unit and a supercritical unit was 1.8 per cent due to steps taken by Trombay authorities in their 6th unit design. Combined cycle power plant suppliers these days offer efficiencies of 48 per cent or so. The fuel cost in a typical combined cycle plant using natural gas would be about 90 p/Kwh when on G.T. mode. The cost per KW of such plants is now at quite high levels (of the order of Rs. 30,000/Kw or more) thereby justifying the need to run them continuously. In practical operation, the combined cycle units have shown efficiencies of the order of 41 per cent which nevertheless is much higher than conventional steam plants. Gas turbine plants are highly sensitive to ambient conditions and their efficiencies also drop off at part loads. The main advantages of the gas turbine power plants are quicker gestation period, quick start-up and low auxiliary consumption of the order of 2.5 per cent for a combined cycle. The drawbacks are a high outflow on spares and for straight out gas turbines, a high generation cost.

The emphasis on increasing PLF could lead to lower levels of efficiency in as much as both boiler and TG efficiency could be adversely affected. With increasing capital costs for new plants, the need to bring down fixed charges would call for high PLF in operation.

A few points have to be made in regard to tables 1 and 4. The Rihand STPS had some problems especially on unit II and for want of adequate details the data on Rihand STPS have been omitted. This plant should occupy a place in the first 10 of the efficiency merit list. Similarly, data relating to Bokaro B were not available separately for A and B and hence, it has been omitted. Bokaro A, though 40 years old, is still achieving an output of 40 to 50 MW. This is the first large sized unit with a rating of 57.5 MW installed in 1952-53 and it was designed to burn coal of 18 per cent ash. It speaks highly about the plant O & M staff that it is still maintaining a good level of generation even though it gets coal of much inferior quality. Data relating to Sabarmati are given in such a way, one could not figure out Sabarmati separately. It is understood that the 110 MW units here are doing excellently. The Neyveli TPS-I is the oldest plant with the high steam temperature of 535°C (995°F) and it has already crossed the originally estimated 100,000 hour creep life, having done more than 180,000 hours in the first unit. Ennore which has the earliest indigenous 60 MW units and 110 MW units and its level of operation is equally commendable, keeping in view the problems faced by it.

Basic information in drawing up the tables is the coal consumed by the power plant as a whole. Power stations usually have belt weighers which integrate the quantity of coal handled in a given period. There are also wagon weighers. It is presumed that the weighing devices were kept in acceptable accuracy limits by periodic checking internally as well as by State agencies such as the Department of Weights and Measures. The main criterion which justifies the use of these values is that agreement between vendor and the consumer is presumed as otherwise the quantities can be disputed. There is a question relating to coal quality. Some organizations have a routine system of referring disputed quality to an arbitrator such as Central Power Research Institute. As these parameters involve different organizations, it is considered reasonable to use them in making the overall assessment of performance of a station. Many power plants have gravimetric coal feeders with which the coal quantities supplied to each pulverizing mill can be assessed. Considering the large number of units/stations, an overview based on the weighted average calorific value of coal has to be taken. Many stations do not have modern apparatus for rapid determination of coal parameters. With the rising coal/fuel costs all major power plants should go in for such instruments, so that the weighted average realistic values can be obtained. Sampling procedures and information on the electrical units (Kilowatt hours) generated should be accurate. Data obtained from CEA Operation Review have been utilized to estimate the heat consumption per kilowatt hour generated.

With the rising coal/fuel costs all major power plants should go in for such instruments, so that the weighted average realistic values can be obtained.

Secondary Oil Consumption

Secondary oil consumption has been furnished in the CEA Review as millilitres per kilowatt hour generated. A heat value is computed for such secondary oil consumed. This will also reflect the number of start ups etc. as oil consumption in boilers based on coal as primary fuel is mostly for start ups. There is also a low

load support. When considering the values over a period, the total heat consumption is indicated by unit heat rate per KW-hour generated plus the heat equivalent for secondary oil consumption. There would also be some quantities of HSD etc. used at the time of initiating burners. Details on such are not available. However, the value of such fuels is likely to be insignificant compared to secondary oil. For example, in a power plant the annual cost of secondary oil was Rs 11 crore whereas the cost of HSD was Rs. 0.29 crore. These figures should be compared with the annual coal cost which was about Rs 156 crores. Thus the secondary oil cost constituted about 7 per cent of the coal cost. This brings out the importance of reducing secondary oil consumption which involves reducing the number of start-ups and periods of low load operations.

The secondary oil consumption for the various power plants covered in the CEA Review for 90—91 varied from 0.67 ml/Kwh to 36.16 ml/Kwh and the average for all the power plants was 7.69 ml/Kwh.

The CEA Review furnishes the auxiliary consumption as a percentage of generation. For coal fired power plants, the auxiliary consumption varied from 7.26 per cent 21.04 per cent and the average for all the power stations was 9.61 per cent. In table 1, the auxiliary consumption was taken as a factor for working out the heat consumption per kilowatt hour sent out.

Plant Factors

PLF can be worked by dividing the gross generation by the product (8760 X installed capacity). CEA have, on the basis of data on planned maintenance outage, forced outage, worked out the availability factor for various units and stations. The values of availability furnished in the CEA Review are presented in table 1. From these values the corresponding partial unavailability factors have been subtracted to arrive at the net availability furnished in the last column in table1. The fact that many power plants have a high level of partial unavailability is an indication of sickness of some vital auxiliaries.

The difference between the net availability and PLF could in most cases be due to system factors calling for load reduction or unit shut down. In the Northern Region, this system factor varied from zero to 21.92 per cent and the factor for the region as a whole was 4.25 per cent. In the Western Region, this factor varied from zero to 18.24 per cent and the average was 2.18 per cent. For the Southern Region the variation was from zero to 5.94 per cent with the average being 1.01 per cent. In the Eastern Region, the variation was from zero to 31.5 per cent with the average being 1.4 per cent. The average for the various power plants as furnished by CEA was 2.39 per cent. This factor is not attributable to the generating stations but is a matter of power system management. The availability varied from 88.96 per cent to 36.26 per cent. The net availability varied from 85.44 per cent to 21.8 per cent. The power plant with the highest availability generated 7344 Kwh/Kw and sent out 6710 Kwh/Kw. The power plant with the lowest availability generated 1898 kwh/Kw and sent out 1645 Kwh/Kw.

Manpower

The values of man/MW for these stations as given by CEA are furnished in table 5 and the annual generation/man for the various plants are estimated .The highest generation of 7.570×10^6 Kwh per man was at Ramagundam and the lowest of 0.362 to 10^6 Kwh per man at Paras.

Table 6 furnishes the installed capacity of various unit sizes, and corresponding generation in 1990—91 from each group. The 500 MW sets constituted 14.4 per cent of the total capacity considered and the generation from these sets was 15.4 per cent of the total generation. 200 MW sets (including 210 MW), constituted 49 per cent of the installed capacity and their generation was 54.4 per cent. Thus this range of units was practically the back bone of the thermal generation sector. While there were 11 units with 500 MW machines, 90 with 200/210 MW, the smaller capacity machines were 146 in number. The CEA Review deals with a total of 284 units of total capacity 38.3 million KW with a total generation of 173.466 billion units. The very first unit of 57.5 MW unit was first commissioned in 1952, the first 100 MW non-reheat in 1967, the first 100 MW reheat unit in 1972, the first 120 MW reheat unit in 1974, the first 150 MW unit in 1965 and 200 MW unit in 1977.

Acknowledgement

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Table 5 : Manpower in Generating Station

NORTHERN REGION POWER STATION	INSTALLED CAPACITY MW	MEN PER MW	GENERATION KWH PER KW	ANNUAL GENERATION PER MAN - MILLION KWHR
RAMAGUNDA STPS	2100	0.6	4542	7.57
SINGRAULI STPS	2000	1.1	6169	5.608
TROMBAY	1330	1.1	4339	3.945
NEYVELI II	630	2.2	6544	2.597
WANAKBORI	1260	1.9	4671	2.458
NASIK	910	2.2	5132	2.332
TITAGARH	240	2.9	6471	2.231
BHUSAWAL	480	2.9	6469	2.231
FARAKKA	630	2.3	4686	2.037
RAICHUR	420	3.4	6671	1.963
KORBA WEST	840	3.1	6030	1.945
UKAI	850	3.0	5467	1.822
BADARPUR	705	3.9	5884	1.509
NEYVELI I	590	4.6	6524	1.423
TURICORIN	630	4.4	6252	1.421
SIKKA (R)	120	3.5	4042	1.155
SATPURA	1142.5	3.5	3637	1.039
ENNORE	450	4.3	4464	1.038
METTUR	840	3.9	3626	0.93
A.E.CO.	434	6.3	5624	0.893
BANDEL	530	4.2	3441	0.819
I.P.STATI	277.5	7.9	5041	0.638
BHATINDA	440	8.5	4941	0.581
DURGAPUR (D)	350	5.5	3006	0.547
TALCHER	460	5.6	2974	0.531
PARAS	80	9.7	3512	0.362

Table 6: Unit-wise Distribution

T.G.NOMIN RATING MW	NUMBER OF UNITS CONSIDERED IN C.E.A OPERATION REVIEW	TOTAL CAPACITY MW	GROSS GENERATION 10 KWHR	PERCENTAGE OF TOTAL CAPACITY	PERCENTAGE OF TOTAL GENERATION
500	11	5500	26720	14.4	15.4
200/210	90	18780	94385	49.0	54.4
140/150	9	1270	4555	3.3	2.6
120	20	2380	8728	6.0	5.3
110	37	4070	13269	10.5	7.6
100	11	1042	5258	2.7	3.0
62.5	21	1295	5556	3.4	3.2
60	22	1305	5338	3.4	3.1
50	26	1135	5032	3.0	2.9

Strategy for Winning Battles in JK Synthetics (ATC Group)

A.K. Bhardwaj & R.S. Gupta

The ATC group of J K Synthetics Ltd is located at Jhalawar, one of the backward areas of Rajasthan. Far away from the city and devoid of most of the infrastructural facilities, the ATC group has developed its marketing and achieved a competitive edge for its products essentially on the strength of its people, the quality of its products and an all pervasive productivity effort. In this paper the Company shares its experience on Chairman's Audit for Quality (CAQ) award, based on a strong foundation of Continuous Quality Improvement (CQI) process and employee participation in the organisation.

A.K Bhardwaj is the General Manager of Utilities and Technical Development and is the coordinator of CAQ activities. R.S.Gupta is a former Dy. Director General, National Productivity Council and now Director, CRTPM, New Delhi and is closely associated with the CAQ scheme.

By virtue of its product range, the ATC Group of J K Synthetics Ltd. has to deal with highly professional, cost and quality conscious customers. Fierce competition, slim profit margin and delivering the products according to the promises made to the customers are the demanding rules of the game to which the company has to adhere to for a growing market share.

In order to meet these challenges, the company's top management team meets every year to visualise the scenario for the next five years, focusing on key issues emerging as a result of the fast changing socio-economic environment in the country and elsewhere. Through active participation which even supports dissension, the top management team evolves a consensual 'vision' which sets long term goals for the company. The company of course, does not lose sight of its imperatives—annual turnover, profitability and exports. But it firmly believes that it is possible to make greater strides in turnover, exports and profitability only by focussing on internationally competitive quality standards, positive work culture, employee empowerment and conducive social environment.

Employee Involvement; Open Communication

Once unanimity has been achieved towards the vision statement, policy statements are formulated in each functional area and action plan is prepared to achieve short term (annual) and long term (5 years) goals. The action plan for achieving the goals is cascaded down to the lowest level by relay method . The key features of this exercise are (a) open communication at all levels of employees supported by transparent records on all aspects of working and (b) using a relay method whereby each level of employee group is addressed by the immediate superior. The management ensures that distortion in facts does not take place in

the top down communication process. Frank discussions are encouraged at all levels to make all employees understand the company's goals. Open communication with freedom to express divergent views has gone a long way in developing 'faith' in the people and the system. We can impart skills and techniques but cannot train for faith. 'Faith' is the most vital and essential ingredient for securing employee involvement and commitment towards achieving the company's short term and long term goals.

Open communication at all levels with freedom to express divergent views has gone a long way in developing 'faith' in the people and the system.

Strategies for Achieving Vision

Every company has to operate in a "survival and growth" cycle. Higher profitability, turnover and exports and zero debt are inevitable goals of any well managed company. They also remain cherished goals of J K Synthetics, ATC group. However, the company relies heavily on softer variables for achieving excellence. The softer variables refer to the emphasis laid on attaining international quality standards, imbibing a philosophy of achieving zero defect, zero waste, zero inventory and zero debt, and making excellence a "norm" and not an "exception" in all functional areas. This has been made possible by continuously upgrading employee skills, by participation in continuous improvements and decision making, by offering career development and growth opportunities, by enabling them to achieve and enjoy highest possible standards of living (in comparison to similar units). The company is located in one of the most backward areas. Through continuous social interventions, it has been influencing the environment as an ongoing process. The results are slow but obvious. The surroundings have now become far more supportive as compared to being fairly hostile in the early days. Specific strategies adopted by the company in each functional area are testimony to the management's concern for all round excellence essentially through their people, quality and productivity. A glimpse of some of the functional strategies bears out this statement.

Manufacturing

Strategy

- To operate with quality manual.
- ISO 9000 to become a benchmark of all activities.
- Manufacturing through statistical process control (SPC).
- Achieving higher productivity through uniform plant load, pull system and reduced set-up time.
- Customer internalisation.
- A few others.

Marketing

Strategy

- To shift emphasis from customer satisfaction to customer delight.
- Ownership of customers.
- Customer technical and support services.
- Others.

Business Services

Strategy

- Vendor selection, development and integration.
- Suppliers quality assurance.
- Reduction in inventories.
- Economic procedures with least paper work and manpower requirement.
- Others.

Human Resource Development

Strategy

- Role clarity and KRA's.
- Potential assessment and career development.
- Performance based compensation reward and recognition.
- On-the-job skill development.
- Flat structure.
- Proactive personnel policies.
- Living in harmony with surroundings.

Motivation - Vision Interface

In accordance with the strategy formulation, annual targets, further broken down monthly, are set for key operational areas. These are continuously monitored for corrective and preventive action. Each operational area is given a "weight" according to its relative importance. The weighted performance is arrived at each month and all the employees, from the chief executive to the lowest level, are given performance-based compensation — which under ideal condition could be 5 times the wage for the non-managerial and 50 per cent of the salary for the managerial category. This has ensured an excellent integration of motivation- achievement - strategies - vision.

Quality—the Vital Strategic Issue

By virtue of its operating under severe competitive environment, the company attaches unmatched importance to quality—not only the quality of products, but also the quality of work performed by each functional area. Quality means not merely meeting customer specifications but exceeding his expectations, adhering to delivery schedules, producing error free products in all the manufacturing stages supported by error-free services rendered by the non-manufacturing departments. This makes the products competitive not only in terms of price but more significantly in terms of the quality of the best known global competitors and, improves profitability through quality and productivity alone. The ATC group deliberately looks for difficult customers who are more demanding. This is one of the most effective methods of keeping everyone alert in the organisation and effect continuous quality improvement in the manufacturing processes, systems, procedures and employee skills. 'Customer delight' is not merely a slogan, it is an obsession with the organisation. Employees in the company continuously strive for supplying a "spliceless" fabric roll though as per standards a given number of knots are permissible. The company does not get price differential by supplying spliceless roll, but it certainly helps everyone in the organisation think in terms of excellence in quality and also in carving out a greater market share for the company. Employees in the ATC group are aware that the company can make profits through quality alone. Dealing with "break spools" in the cording section or with "spliced rolls" in the weaving section is far more expensive than handling full spools or spliceless rolls.

Quality means not merely meeting customer specifications but exceeding his expectations.

Chairman's Audit for Quality (CAQ) Award

In order to institutionalise the organisation's effort for achieving excellence in quality, continuous quality improvement (CQI) process was launched with the objective of reducing costs, improving operating effectiveness, achieving a state of continuous improvement for satisfying (and even exceeding) customer needs. Through CQI, the company places a concerted focus on quality and customer, customer internalisation, integration of supplier -manufacturer - customer, emphasis on doing right the first time and prevention of defects, focus on people and culture, promoting continuous improvements through quality circles and cross functional task forces. Every employee is trained in the basic tools and techniques of improving quality and productivity, as the company believes that no measurement is possible without recording, no recording is warranted without analysis, no analysis without action and no benefit without problem elimination. The company's goal is zero defect and CQI steers it in the right direction.

No measurement is possible without recording, no recording is warranted without analysis, no analysis without action and no benefit without problem elimination.

With the stabilisation of the CQI process not only in ATC group but in all other units of J K Synthetics, it was decided to launch an award for excellence in quality, popularly known as the Chairman's Audit for Quality (CAQ). The main objective of this award is to encourage the work force to improve the overall performance of their unit with special reference to the concept of total quality management and innovativeness.

CAQ award is given to the following categories:-

a) Unit award for excellence in quality.

b) Individual award for promotion of quality.

   i) From Clerks to Asst. Officers group

   ii) From Officers to Managers group

All the units are eligible to participate in (a) type award and individuals in (b) type. There are 3 awards—one in (a) catagory and two in (b) category, one for each group.

CAQ Evaluation Criteria

The evaluation criteria for the unit award and individual award are as follows:

Units Participation

Parameters	Total Points
Quality policy	20
Organisation for Quality—for promotion, achievements, responsibilities and monitoring	80
Production planning and development—modifications in systems, processes, procedures	70
Manufacturing quality - specifications, process capability, process control, final product quality, 7 tools of QC, materials and systems traceability, fool proofing of systems and instruments	80
Maintenance systems and their impact	80
Inspection and testing—incoming inspection, manuals, testing equipments, audit	60
Packing and despatch	30
Data collection and analysis—use of statistical methods and quality information flow	60
Customer service—complaints, actions, ownership	75
Cost of Quality—QA, quality control, quality failure, lost opportunities, etc	80
New product development	35
Quality Audit	40
Motivation schemes	70
Group team achievement	60
Training and education	60
Safety and pollution control	50
5 - S Practices	50
Total	1000

Individual Participation (Officers to Managers)

Part A

Total Quality Management

Parameters	Total Points
Training & Education—promoting, conducting	50
Implementation of QA practices	50
implementation of SQC/7 tools and results achieved thereof	50
Promotion of Quality cCrcles, suggestion scheme	50
Project studies on chronic problems	100
Systems and procedures	75
Customer orientation/satisfaction	75
Training programmes/workshops/seminars attended and work done thereafter	50
Publication/presentation of papers/cases	50
Achievement through task force/group/team work	50
5—S practices instituted/followed	50
Part B	
Innovation	350
Total	1000

In the case of Clerks to Asst. Officers, all the parameters, excepting the first one—promotion and training and education activities, are considered. In this case 25 additional points are given to promotion of quality circles and suggestion schemes and equal number of additional points for participation in training and work done thereafter.

Dividends of CAQ

All the measures taken by the management, particularly CAQ have revolutionalised the work environment. Individual approach has given way to team work. A small group of employees is fully responsible and accountable for production, quality, cost, maintenance and house keeping in their own work area. The management jargon is "self-control" by the employees. There is no such designation as a worker or a supervisor. The supervisors are known by the designation of Asst. Engineers or Coordinators and workmen by the designation of technicians. The coordinator is not a police person. He facilitates in solving the problems encountered by the "self-control' group in discharging their duties. Innovation is a "mantra" continuously recited and practiced by everybody. The conference room remains virtually fully occupied with the meetings of small group activities, the Quality circles or Cross Functional Task Forces. Suggestions for functional improvements are encouraged and widely supported by the management. Anyone can tag his suggestion on the designated display board. The suggestion moves through various stages quickly. As it moves through acceptance to implementation stage, the employee becomes a star General. New ideas either generated internally or acquired from outside are received enthusiastically and experimented with great care. The result is continuous improvement all round.

New ideas either generated internally or acquired from outside are received enthusiastically and experimented with great care. The result is continuous improvement all round.

Industrial yarn fibre division of ATC Group has been the CAQ award winner for 1991. Improvement in the work environment as a result of implementation of CAQ scheme is indeed rewarding. First quality percent has been improved from 90 to 98 per cent which is now being consistently maintained. Improvement in other factors—material utilisation, waste reduction, production increase and reduction in stocks are shown graphically in figures 1 to 7.

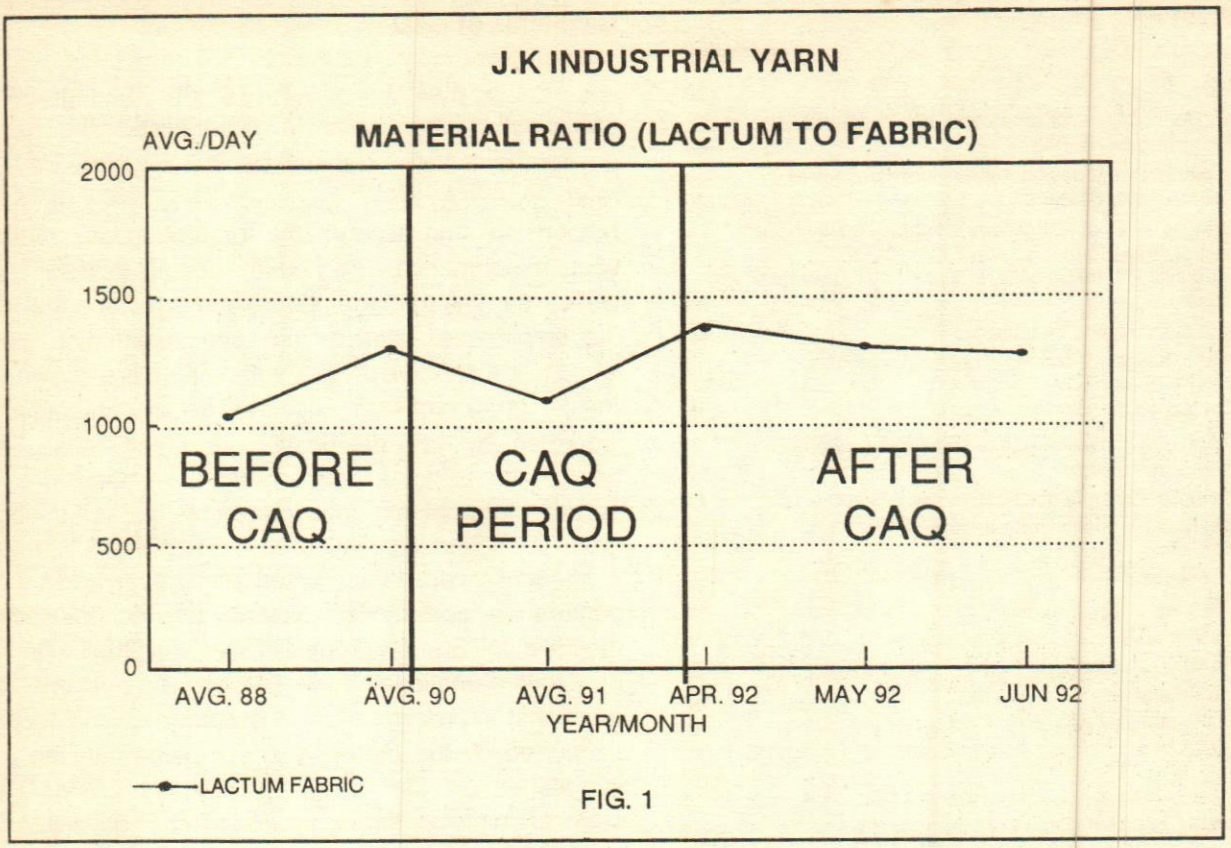
J.K INDUSTRIAL YARN
MATERIAL RATIO (LACTUM TO FABRIC)
AVG./DAY
2000
1500
1000
500
0
BEFORE CAQ
CAQ PERIOD
AFTER CAQ
AVG. 88
AVG. 90
AVG. 91
APR. 92
MAY 92
JUN 92
YEAR/MONTH
LACTUM FABRIC

FIG. 1

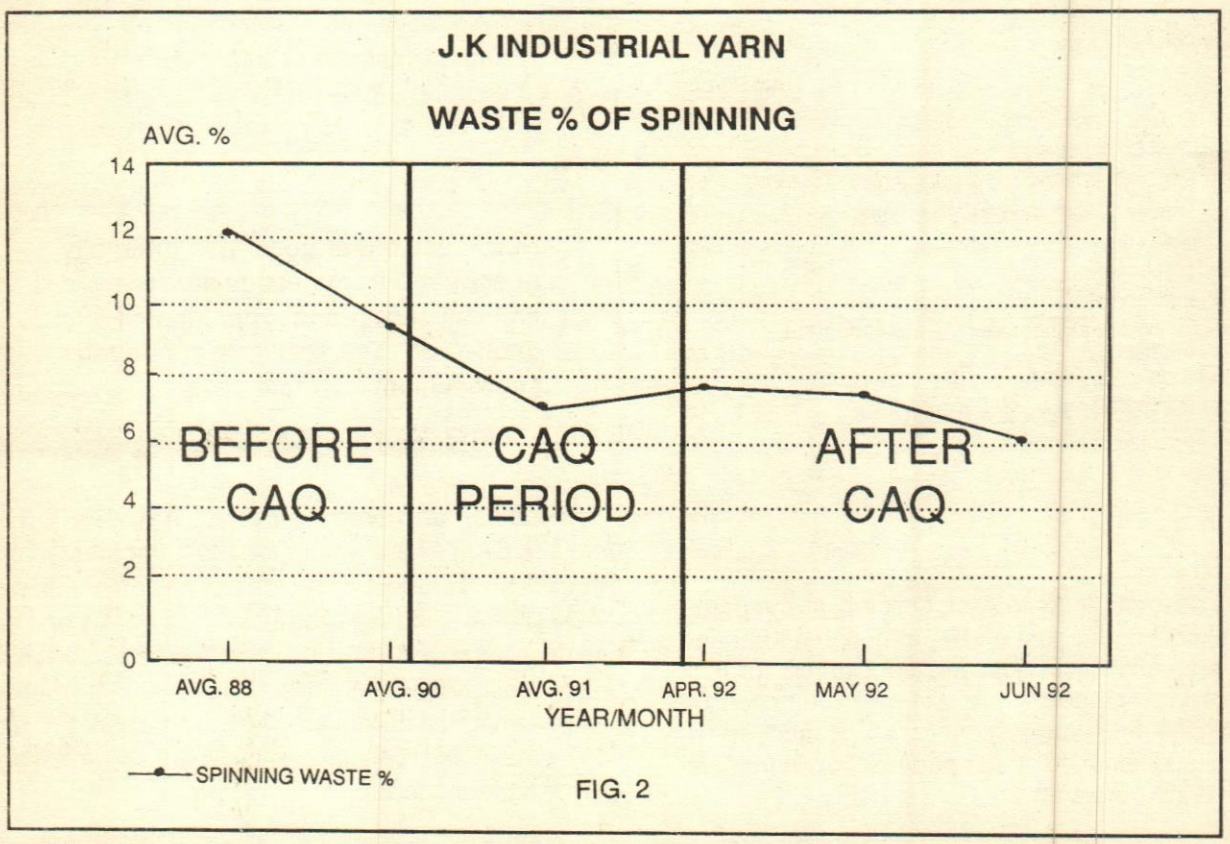
J.K INDUSTRIAL YARN
WASTE % OF SPINNING
AVG. %
14
12
10
8
6
4
2
0
BEFORE CAQ
CAQ PERIOD
AFTER CAQ
AVG. 88
AVG. 90
AVG. 91
APR. 92
MAY 92
JUN 92
YEAR/MONTH
SPINNING WASTE %

FIG. 2

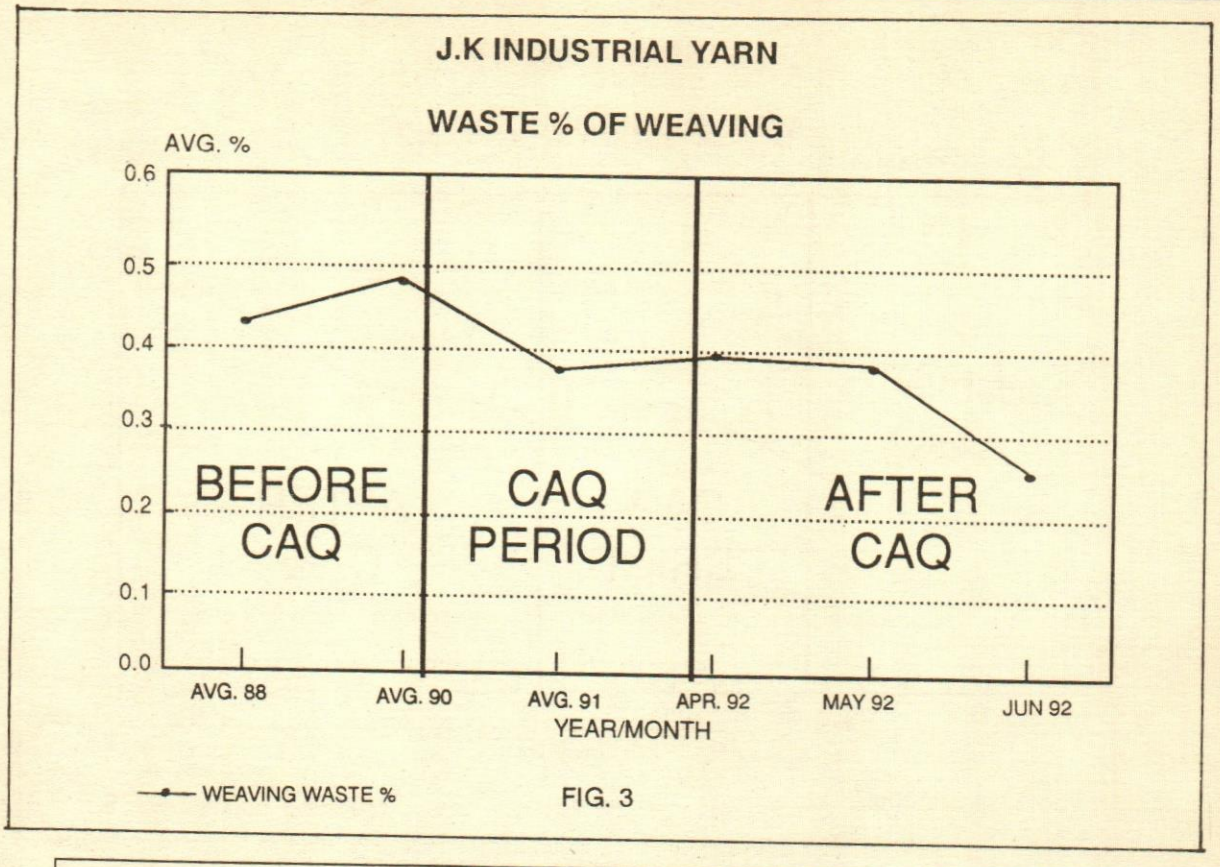
J.K INDUSTRIAL YARN
WASTE % OF WEAVING
AVG. %
0.6
0.5
0.4
0.3
0.2
0.1
0.0
BEFORE CAQ
CAQ PERIOD
AFTER CAQ
AVG. 88
AVG. 90
AVG. 91
APR. 92
MAY 92
JUN 92
YEAR/MONTH
WEAVING WASTE %

FIG. 3

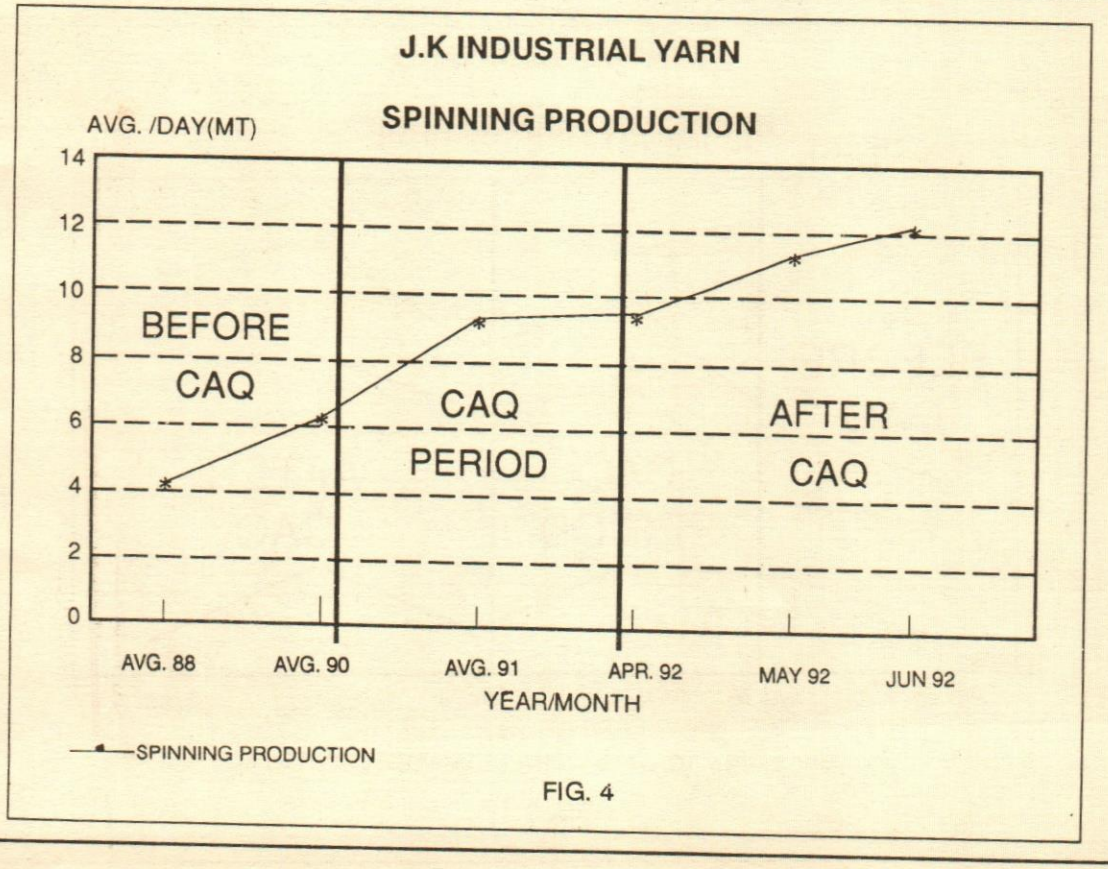
J.K INDUSTRIAL YARN
SPINNING PRODUCTION
AVG. /DAY(MT)
14
12
10
8
6
4
2
0
BEFORE CAQ
CAQ PERIOD
AFTER CAQ
AVG. 88
AVG. 90
AVG. 91
APR. 92
MAY 92
JUN 92
YEAR/MONTH
SPINNING PRODUCTION

FIG. 4

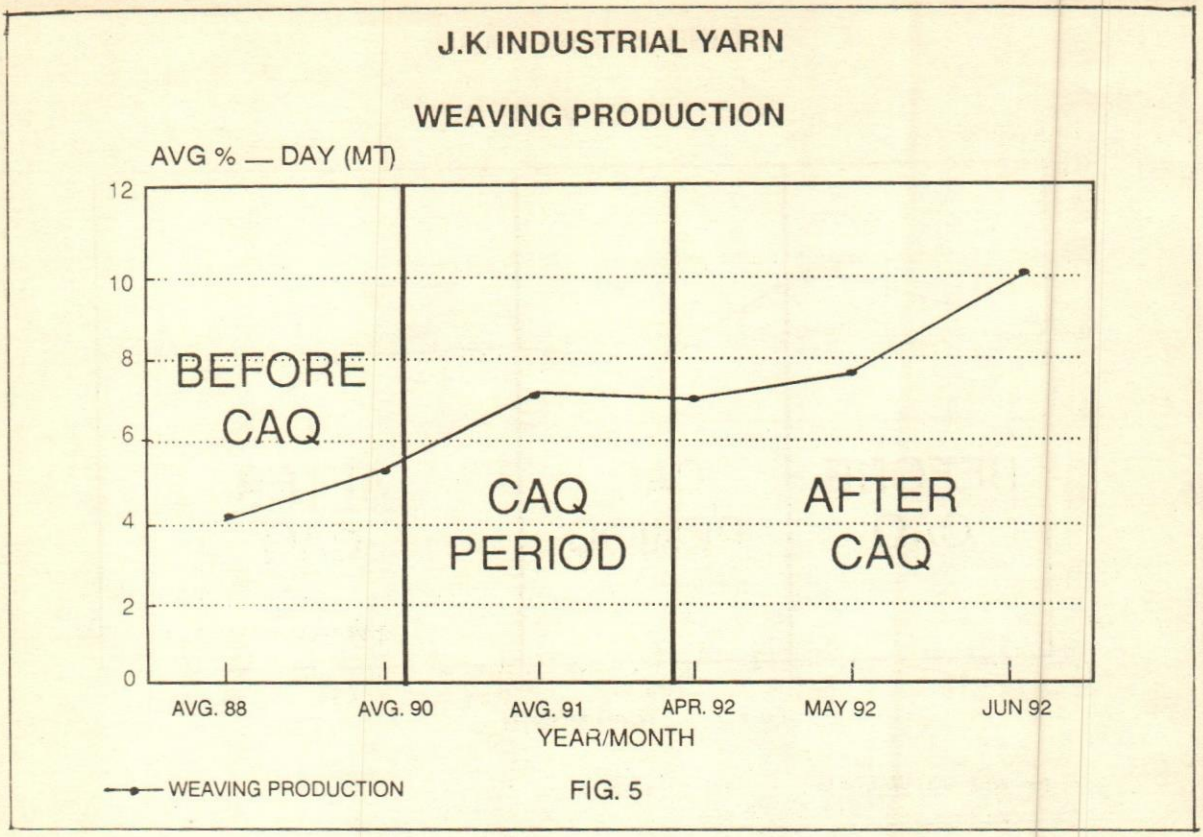
J.K INDUSTRIAL YARN
WEAVING PRODUCTION
AVG % — DAY (MT)
12
10
8
6
4
2
0
BEFORE CAQ
CAQ PERIOD
AFTER CAQ
AVG. 88
AVG. 90
AVG. 91
APR. 92
MAY 92
JUN 92
YEAR/MONTH
WEAVING PRODUCTION

FIG. 5

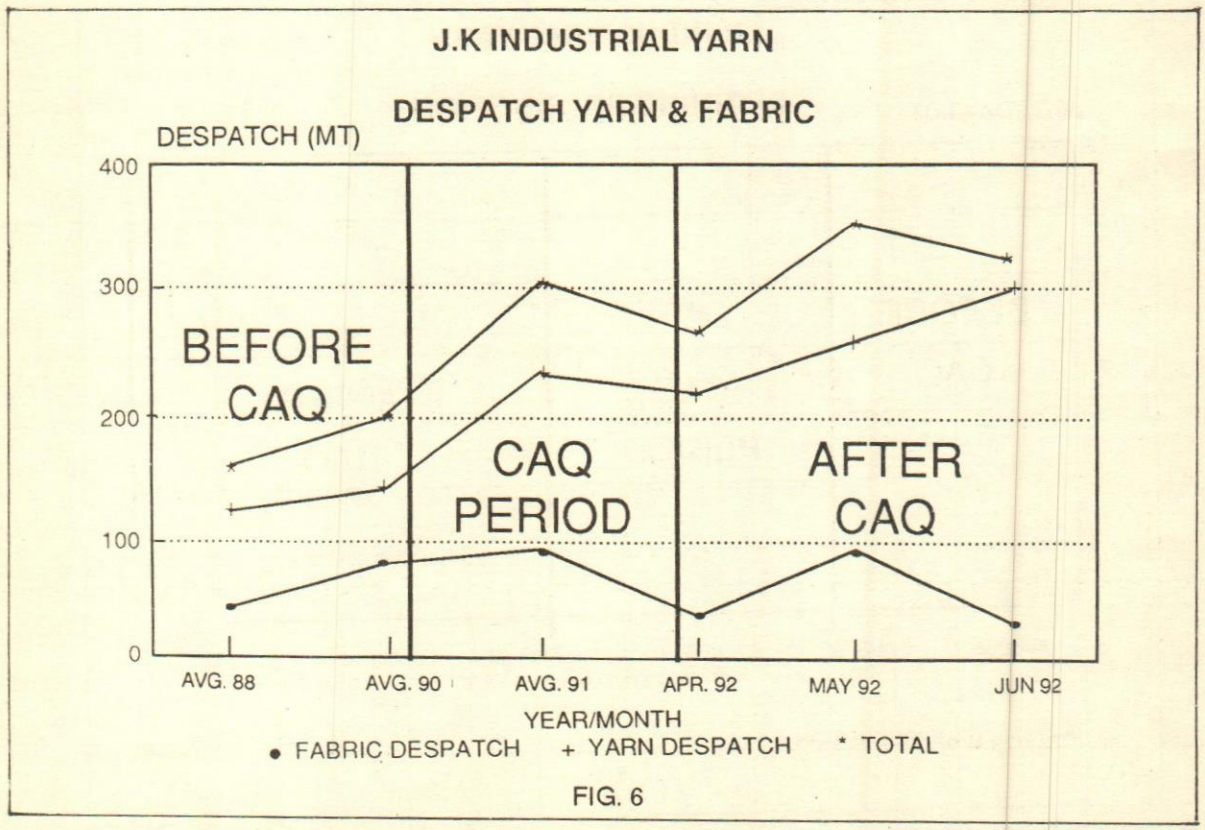
J.K INDUSTRIAL YARN
DESPATCH YARN & FABRIC
DESPATCH (MT)
400
300
200
100
0
BEFORE CAQ
CAQ PERIOD
AFTER CAQ
AVG. 88
AVG. 90
AVG. 91
APR. 92
MAY 92
JUN 92
YEAR/MONTH
• FABRIC DESPATCH
+ YARN DESPATCH
* TOTAL

FIG. 6

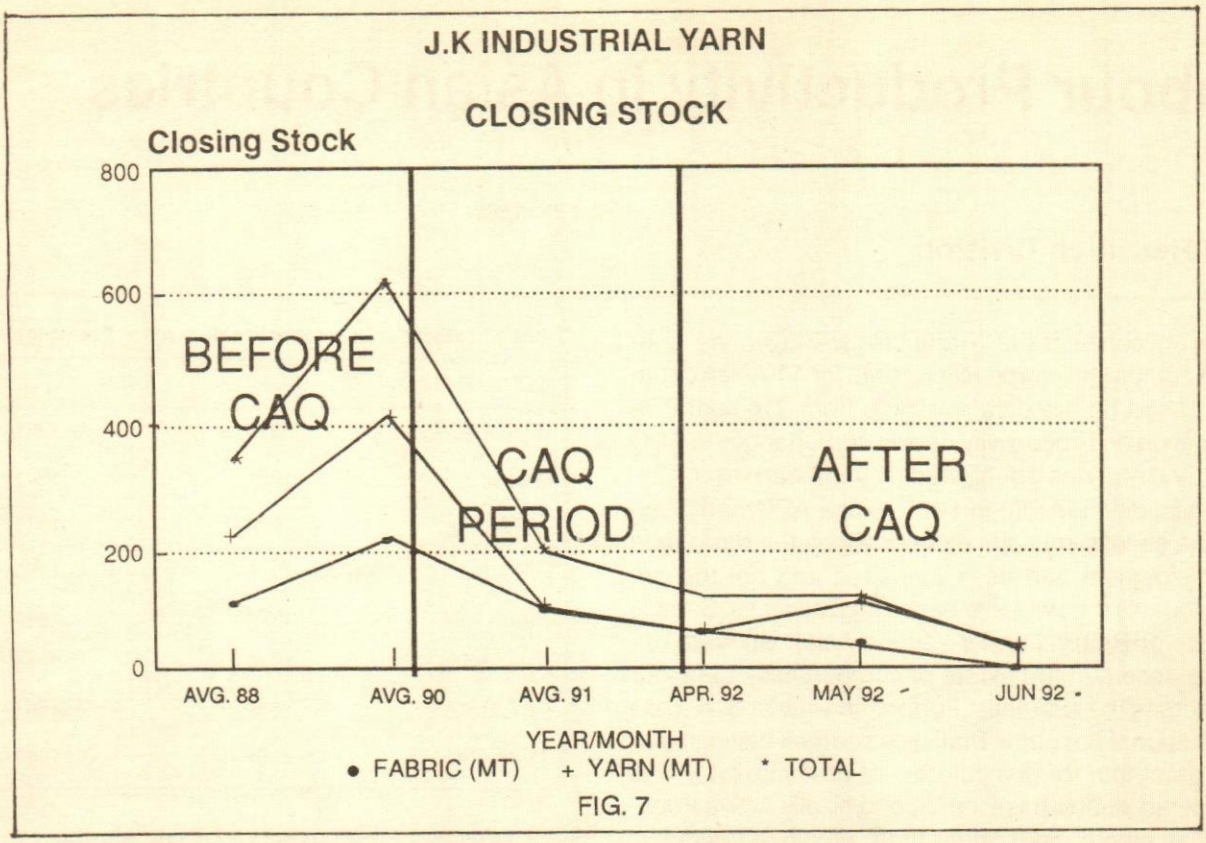

FIG. 7

Conclusion

Continuous effort is being made to transform the ATC group into a trend setter in quality and productivity, initially among the same industry sub-sector and subsequently in the Indian industry. It has succeeded to a great measure but everyone is aware of the long journey ahead of them. The ATC group is destined to succeed through the innovative, quality and productivity effort of its people—the real wealth of the organisation.

Labour Productivity in Asian Countries

NPC Research Division

In an earlier issue [Productivity, 32(2)], we published comparative productivity data for 11 Asian countries, based on the data available from "Comparative Information on Productivity Levels and Changes in APO Member Countries", published by the Asian Productivity Organisation (APO) in 1990. Since APO had given only the secondary sources from which the basic data on employment had been extracted and not the primary sources (i.e., whether based on Censuses, Sample Surveys or Returns under various Acts), we were unable to ascertain the extent of comparability of labour data across the countries. Further, in view of GDP data from National Accounts Statistics sources having been used as output for computation of productivity, it was considered ideal to base the `Economically Active Population' as labour input rather than `employed persons' as used by the APO study. This is more so because of the likely variations in the definition of `Employment' across country sources, i.e., whether `fully employed', `gainfully employed' or `underemployed' etc.

The present study has used the concept of 'Economically Active Population'as the input measure for productivity computations. The data for this purpose has been taken from the ILO's 'The Yearbook of Labour Statistics,' for various years. The 'Economically Active Population' is defined by the ILO Yearbook as 'the group of all persons of either sex who furnish the supply of labour for the production of economic goods and services as defined by the United Nations Systems of National Accounts and Balances, during a specified time-reference period'. It includes all persons who fulfill the requirements for inclusion among the 'employed' or the 'unemployed'. The data has been compiled by the ILO from various countries' population censuses for various years.

Table 1 : Latest Census Years in select Asian Countries

COUNTRY	YEARS	
BANGLADESH	1974	1981
INDIA	1971	1981
JAPAN	1980	1985
REPUBLIC OF KOREA	1975	1980
PAKISTAN	1972	1981
PHILIPPINES	1970	1975
SRILANKA	1971	1981
THAILAND	1970	1980

The labour data used for computations in the present study has been projected based on compound growth rate of persons in individual sectors, between the latest two census years, for each country. Table 1 gives the census years, the data of which has been used for each country. Persons in the total economy is the sum of those in individual sectors (Table 2).

Output is measured in terms of Gross Domestic Product (GDP) in individual sectors. The data has been taken from APO's 'Comparative Information on Productivity Levels and Changes in APO Member Countries', already mentioned. GDP figures at current prices are converted into 1985 constant US dollars, by applying the appropriate exchange rates (Table 3). The Labour Productivity ratios thus arrived at are given in Table 4.

Complied by
N.K. Nair
K. Suryanarayanan

Table 2 : Estimated Economically Active Population

(in Lakhs)

INDUSTRY	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
BANGLADESH*										
AGRICULTURE, HUNTING, FORESTRY & FISHING	139.01	141.83	144.70	147.64	150.63	153.69	156.80	159.98	163.23	166.54
MINING, QUARRYING & MANUFACTURING	21.36	21.81	22.26	22.71	23.17	23.64	24.12	24.61	25.10	25.61
ELECTRICITY, GAS & WATER	0.57	0.58	0.59	0.61	0.62	0.63	0.64	0.66	0.67	0.68
CONSTRUCTION	4.12	4.20	4.29	4.38	4.46	4.56	4.65	4.74	4.84	4.94
WHOLESALE & RETAIL TRADE & HOTELEERING	27.51	28.07	28.64	29.22	29.81	30.41	31.03	31.66	32.30	32.96
TRANSPORT, STROAGE & COMMUNICATION	8.94	9.12	9.31	9.49	9.69	9.88	10.08	10.29	10.50	10.71
FINANCIAL, INSURANCE, REAL ESTATE & BUSINESS SERVICES	1.15	1.17	1.20	1.22	1.25	1.27	1.30	1.32	1.35	1.38
COMMUNITY, SOCIAL & PERSONNEL SERVICES	19.39	19.78	20.18	20.59	21.01	21.44	21.87	22.32	22.77	23.23
NOT ADEQUATELY DEFINED	14.12	14.41	14.70	15.00	15.30	15.61	15.93	16.25	16.58	16.92
TOTAL	236.19	240.98	245.87	250.85	255.94	261.13	266.42	271.83	277.34	282.96
INDIA										
AGRICULTURE, HUNTING, FORESTRY & FISHING	1620.60	1650.60	1681.15	1712.26'	1743.96	1776.24	1809.11	1842.60	1876.70	1911.44
MINING & QUARRYING	13.50	14.02	14.57	15.13	15.72	16.33	16.96	17.62	18.30	19.01
MANUFACTURING	266.40	278.53	291.21	304.46	318.32	332.81	347.96	363.80	380.36	397.68
ELECTRICITY, GAS & WATER	10.40	11.12	11.88	12.70	13.57	14.50	15.50	16.57	17.71	18.93
CONSTRUCTION	39.40	41.73	44.19	46.80	49.57	52.50	55.60	58.89	62.37	66.05
TRADE & COMMERCE	149.20	157.23	165.70	174.62	184.02	193.93	204.37	215.37	226.96	239.18
TRANSPORT, STORAGE & COMMUNICATION	64.90	67.47	70.14	72.91	75.80	78.79	81.91	85.15	88.52	92.02
OTHERS	211.20	215.36	219.60	223.93	228.34	232.84	237.43	242.11	246.88	251.74
TOTAL	2375.60	2436.05	2498.43	2562.82	2629.30	2697.94	2768.85	2842.10	2917.80	2996.05
JAPAN										
AGRICULTURE, HUNTING, FORESTRY & FISHING	59.64	58.21	56.82	55.45	54.12	52.82	51.56	50.32	49.11	47.93
MINING & QUARRYING	1.05	1.03	1.00	0.98	0.95	0.93	0.91	0.88	0.86	0.84
MANUFACTURING	133.88	135.32	136.77	138.24	139.73	141.23	142.74	144.27	145.82	147.39
ELECTRICITY, GAS & WATER	3.46	3.44	3.41	3.39	3.37	3.35	3.32	3.30	3.28	3.25
CONSTRUCTION	53.60	53.36	53.13	52.89	52.66	52.43	52.20	51.97	51.75	51.52
WHOLESALE & RETAIL TRADE & HOTELEERING	128.59	129.88	131.18	132.50	133.82	135.17	136.52	137.89	139.27	140.67
TRANSPORT, STORAGE & COMMUNICATION	35.05	35.07	35.08	35.09	35.10	35.11	35.12	35.14	35.15	35.16
FINANCIAL, INSURANCE, REAL ESTATE & BUSINESS SERVICES	20.43	20.83	21.24	21.66	22.09	22.53	22.97	23.43	23.89	24.36
COMMUNITY, SOCIAL & PERSONNEL SERVICES	126.35	129.65	133.03	136.50	140.06	143.71	147.46	151.31	155.25	159.30
NOT ADEQUATELY DEFINED	0.75	0.92	1.12	1.36	1.67	2.03	2.48	3.03	3.69	4.51
TOTAL	562.81	567.70	572.78	578.07	583.57	589.31	595.29	601.53	608.07	614.93
REPUBLIC OF KOREA										
AGRICULTURE, HUNTING, FORESTRY & FISHING	45.53	43.24	41.06	38.99	37.03	35.16	33.39	31.71	30.11	28.60
MINING & QUARRYING	0.90	0.90	0.89	0.89	0.88	0.88	0.87	0.87	0.86	0.86
MANUFACTURING	29.32	30.73	32.21	33.76	35.38	37.08	38.87	40.74	42.70	44.76

Table 2 (*Contd.*)

INDUSTRY	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
ELECTRICITY, GAS & WATER	0.37	0.37	0.37	0.38	0.38	0.38	0.39	0.39	0.39	0.40
CONSTRUCTION	7.08	7.54	8.03	8.56	9.11	9.71	10.34	11.02	11.74	12.50
WHOLESALE & RETAIL TRADE & HOTELEERING	21.40	22.25	23.14	24.06	25.01	26.01	27.04	28.11	29.23	30.39
TRANSPORT, STORAGE & COMMUNICATION	5.79	6.08	6.39	6.71	7.04	7.39	7.76	8.15	8.56	8.99
FINANCIAL, INSURANCE, REAL ESTATE & BUSINESS SERVICES	3.25	3.69	4.19	4.77	5.42	6.15	6.99	7.95	9.03	10.26
COMMUNITY, SOCIAL & PERSONAL SERVICES	14.09	14.15	14.21	14.27	14.33	14.39	14.45	14.52	15.58	14.64
UNEMPLOYED	9.72	10.34	11.01	11.72	12.47	13.27	14.13	15.04	16.00	17.03
TOTAL	137.45	139.29	141.50	144.09	147.06	150.44	154.25	158.50	163.22	168.44
PAKISTAN"										
AGRICULTURE, HUNTING, FORESTRY & FISHING	115.60	117.38	119.20	121.04	122.91	124.81	126.74	128.70	130.69	132.71
MINING & QUARRYING	0.87	0.81	0.76	0.70	0.66	0.61	0.57	0.53	0.49	0.46
MANUFACTURING	20.08	20.86	21.68	22.52	23.40	24.32	25.27	26.26	27.29	28.35
ELECTRICITY, GAS & WATER	1.31	1.63	2.02	2.52	3.13	3.89	4.84	6.02	7.49	9.32
CONSTRUCTION	9.19	9.37	9.54	9.72	9.91	10.09	10.28	10.48	10.68	10.88
WHOLESALE & RETAIL TRADE & HOTELEERING	20.64	21.25	21.87	22.51	23.17	23.85	24.55	25.27	26.01	26.78
TRANSPORT, STORAGE & COMMUNICATION	9.08	9.38	9.70	10.02	10.36	10.71	11.07	11.45	11.83	12.23
FINANCIAL, INSURANCE, REAL ESTATE & BUSINESS SERVICES	1.66	1.72	1.77	1.83	1.89	1.95	2.01	2.08	2.14	2.21
COMMUNITY, SOCIAL & PERSONNEL SERVICES	30.03	31.12	32.24	33.41	34.62	35.87	37.17	38.52	39.91	41.36
NOT ADEQUATELY DEFINED	10.79	11.05	11.32	11.61	11.91	12.22	12.55	12.90	13.28	13.68
UNEMPLOYED	7.02	7.19	7.37	7.55	7.75	7.95	8.16	8.39	8.64	8.90
TOTAL	226.26	231.75	237.47	243.45	249.71	256.29	263.24	270.60	278.46	286.88
PHILLIPPINES***										
AGRICULTURE, HUNTING, FORESTRY & FISHING	72.66	73.58	74.50	75.44	76.38	77.34	78.31	79.30	80.29	81.30
MINING & QUARRYING	0.66	0.68	0.69	0.71	0.72	0.74	0.75	0.77	0.79	0.80
MANUFACTURING	12.45	12.32	12.19	12.06	11.93	11.81	11.68	11.56	11.44	11.32
ELECTRICITY, GAS & WATER	0.38	0.39	0.39	0.40	0.40	0.41	0.41	0.42	0.42	0.43
CONSTRUCTION	3.68	3.60	3.53	3.46	3.39	3.32	3.25	3.18	3.12	3.06
WHOLESALE & RETAIL TRADE & HOTELEERING	11.47	11.88	12.31	12.75	13.21	13.68	14.17	14.67	15.20	15.74
TRANSPORT, STORAGE & COMMUNICATION	5.39	5.42	5.44	5.46	5.49	5.52	5.54	5.57	5.59	5.62
SERVICES	24.76	25.24	25.73	26.22	26.73	27.24	27.76	28.30	28.84	29.40
NOT ADEQUATELY DEFINED	1.58	1.56	1.53	1.50	1.47	1.45	1.42	1.39	1.37	1.34
UNEMPLOYED	22.00	25.06	28.55	32.52	37.05	42.20	48.07	54.76	62.37	71.05
TOTAL	155.06	159.72	164.86	170.52	176.77	183.69	191.37	199.91	209.43	220.05

Table 2 (*Contd.*)

INDUSTRY	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
					SRILANKA					
AGRICULTURE, HUNTING, FORESTRY & FISHING	18.76	18.81	18.85	18.90	18.95	19.00	19.05	19.09	19.14	19.19
MINING & QUARRYING	0.34	0.37	0.41	0.45	0.49	0.54	-0.60	0.66	0.72	0.79
MANUFACTURING	4.09	4.16	4.24	4.32	4.40	4.49	4.57	4.66	4.74	4.83
ELECTRICITY, GAS & WATER	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.25
CONSTRUCTION	1.35	1.37	1.41	1.45	1.48	1.52	1.56	1.60	1.65	1.69
WHOLESALE & RETAIL TRADE & HOTELEERING	4.37	4.48	4.59	4.70	4.82	4.93	5.05	5.18	5.30	5.43
TRANSPORT, STORAGE & COMMUNICATION	2.00	2.02	2.04	2.06	2.09	2.11	2.13	2.15	2.18	2.20
FINANCIAL, INSURANCE, REAL ESTATE & BUSINESS SERVICES	0.57	0.62	0.67	0.73	0.79	0.86	0.93	1.01	1.10	1.20
COMMUNITY, SOCIAL & PERSONNEL SERVICES	5.88	5.98	6.09	6.20	6.31	6.42	6.53	6.65	6.77	6.89
NOT ADEQUATELY DEFINED	3.69	3.75	3.81	3.88	3.94	4.01	4.07	4.14	4.21	4.27
UNEMPLOYED	8.97	9.03	9.09	9.15	9.22	9.28	9.34	9.40	9.47	9.53
TOTAL	50.17	50.77	51.39	52.03	52.68	53.36	54.06	54.77	55.52	56.28
					THAILAND* **					
AGRICULTURE, HUNTING, FORESTRY, FISHING	170.33	174.32	17.84	182.58	186.86	191.24	195.72	200.31	205.00	209.80
MINING & QUARRYING	0.93	0.93	0.94	0.94	0.95	0.96	0.96	0.97	0.97	0.98
MANUFACTURING	14.10	15.06	16.08	17.18	18.35	19.60	20.93	22.36	23.88	25.51
ELECTRICITY, GAS & WATER	0.68	0.74	0.81	0.89	0.97	1.06	1.16	1.27	1.39	1.52
CONSTRUCTION	3.74	4.00	4.27	4.56	4.87	5.20	5.56	5.93	6.34	6.77
COMMERCE	17.07	18.14	19.27	20.47	21.75	23.12	24.56	26.10	27.73	29.46
TRANSPORT, STORAGE & COMMUNICATION	4.42	4.63	4.84	5.06	5.30	5.55	5.80	6.07	6.35	6.65
SERVICES	21.42	22.60	23.86	25.18	26.57	28.04	29.59	31.23	32.96	34.78
NOT ADEQUATELY DEFINED	6.35	6.56	6.78	7.01	7.25	7.50	7.76	8.03	8.32	8.61
UNEMPLOYED	7.24	7.48	7.73	7.99	8.26	8.55	8.84	9.15	9.48	9.82
TOTAL	246.27	254.46	262.99	271.87	281.14	290.81	300.90	311.43	322.42	333.91

Note * The total Economically Active Population has been first projected based on compound growth rate of persons between the latest two census years and then allocated to different sectors based on proportion in the latest census period.

** 'Not adequately defined' and 'unemployed' have been estimated as fixed proportions of total Economically Active population.

*** 'Services' comprise Financial, Insurance, Real Estate & Business Services and Community, Social & Personnel Services.

Table 3 : GDP at 1985 US Dollars (in millions)

INDUSTRY	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
					BANGLADESH					
AGRICULTURE, HUNTING, FORESTRY & FISHING	4732	5048	5271	5534	5590	5773	5796	5752	5691	6129
MINING, QUARRYING & MANUFACTURING	1176	1182	1171	1232	1319	1354	1460	1469	1511'	1620
ELECTRICITY, GAS & WATER	38	44	68	73	77	87	106	123	159	167
CONSTRUCTION	549	569	550	660	741	753	805	904	948	1009
WHOLESALE & RETAIL TRADE & HOTELEERING	1217	1147	1207	1187	1227	1276	1328	1371	1436	1490
TRANSPORT, STROAGE & COMMUNICATION	1234	1280	1373	1431	1502	1553	1721	1785	1862	1952
FINANCIAL, INSURANCE, REAL ESTATE & BUSINESS SERVICES	208	193	183	193	227	286	302	306	310	313
COMMUNITY, SOCIAL & PERSONNEL SERVICES	322	288	353	328	435	524	565	610	653	704
NOT ADEQUATELY DEFINED	1856	1937	2030	2130	2216	2341	2464	2648	2777	2916
TOTAL	11331	11690	12204	12767	13333	13947	14548	14968	15345	16301
					INDIA					
AGRICULTURE, HUNTING, FORESTRY & FISHING	56905	56202	62283	62306	62479	61419	61673	71161	73639	76714
MINING & QUARRYING	3843	4292	4400	4472	4705	5352	5531	5997	6228	6483
MANUFACTURING	26046	27751	30503	32475	33778	36140	38769	42011	44952	48216
ELECTRICITY GAS & WATER	2882	3073	3303	3647	3953	4362	4706	5263	5777	6249
CONSTRUCTION	9405	8968	9595	9959	10470	10805	11199	11765	12147	12686
TRADE & COMMERCE	20019	21143	22254	23212	25103	26636	27939	30558	31899	34303
TRANSPORT, STORAGE & COMMUNICATION	8618	9005	9593	10467	11399	12174	13120	14186	15414	16303
OTHERS	28742	30929	32366	34589	36874	39509	42373	45449	50241	53015
TOTAL	156460	161363	174297	181127	188761	196397	205310	226390	240337	253969
					JAPAN					
AGRICULTURE HUNTING, FORESTRY & FISHING	38733	40634	41347	42937	42818	41947	43285	41899	43298	43942
MINING & QUARRYING	4763	4944	4624	4229	4018	4174	3930	4024	3732	4013
MANUFACTURING	313543	327535	341749	370696	396884	386152	414439	452752	488888	524881
ELECTRICITY, GAS & WATER	34905	37181	39546	40117	43202	43755	44788	47919	50108	55809
CONSTRUCTIION	114714	112026	103755	103605	106403	110240	122093	134447	140952	147613
WHOLESALE, RETAIL TRADE & HOTELEERING	317731	331847	346579	355727	374053	385926	398070	416684	436915	472658
TRANSPORT, STORAGE, & COMMUNICATION	73627	74443	78417	83742	88399	89580	91963	97569	103283	107994
FINANCIAL INSURANCE, REAL ESTATE & BUSINESS SERVICES	169692	171531	180835	194302	206801	220137	236043	252211	269716	274157
COMMUNITY, SOCIAL & PERSONNEL SERVICES	102371	104481	106312	108426	110189	111104	112262	113187	113871	114433
NOT ADEQUATELY DEFINED	21580	22605	23809	25023	26069	26995	27777	28999	29880	30124
TOTAL	1191659	1227227	1266973	1328804	1398836	1420010	1494650	1589691	1680643	1775624

Table 3 (*Contd.*)

INDUSTRY	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
REPUBLIC OF KOREA										
AGRICULTURE, HUNTING, FORESTRY & FISHING	10057	10806	11642	11468	11898	12448	11606	12531	12443	11901
MINING & QUARRYING	898	804	849	876	909	984	972	966	901	804
MANUFACTURING	18219	19440	22433	26322	28195	33353	39608	44926	46576	50520
ELECTRICITY, GAS & WATER	1358	1434	1841	2297	2605	3265	3667	4028	4434	5201
CONSTRUCTION	4536	5377	6518	6881	7185	7541	8499	9307	10738	13203
WHOLESALE & RETAIL TRADE & HOTELEERING	8215	8852	9670	10042	11303	13179	15146	16820	17372	18937
TRANSPORT, STORAGE & COMMUNICATION	5211	5518	6004	6749	7074	7767	8773	9804	10768	12031
FINANCIAL, INSURANCE, REAL ESTATE & BUSINESS SERVICES	5647	6069	6779	7295	8347	9165	10643	12508	13875	15141
COMMUNITY, SOCIAL & PERSONNEL SERVICES	6165	6371	6520	6595	6721	6948	7182	7506	7842	8214
TOTAL*	66223	71058	79425	86901	92924	104444	117013	130428	138421	150872
PAKISTAN										
AGRICULTURE, HUNTING FORESTRY & FISHING	6625	6917	6583	7302	7737	7988	8206	8769	9009	9473
MINING & QUARRYING	139	138	140	159	197	212	238	250	274	297
MANUFACTURING	3395	3634	3921	4238	4558	4901	5389	5605	5923	6265
ELECTRICITY, GAS & WATER	460	491	558	572	639	704	818	925	1055	1162
CONSTRUCTION	998	971	981	1073	1144	1287	1354	1378	1427	1492
WHOLESALE & RETAIL TRADE & HOTELEERING	3233	3504	3665	4094	4369	4630	5043	5312	5525	5809
TRANSPORT, STORAGE & COMMUNICATION	1869	2018	2184	2358	2475	2653	2835	2727	2907	3152
FINANCIAL, INSURANCE, REAL ESTATE & BUSINESS SERVICES	1602	1709	1817	1925	2066	2207	2340	2498	2656	2830
COMMUNITY, SOCIAL & PERSONNEL SERVICES	1955	2155	2326	2397	2526	2666	2777	2997	3077	3137
NOT ADEQUATELY DEFINED	1566	1789	2071	2203	2295	2377	2510	2618	2725	2858
TOTAL	21842	23326	24246	26321	28006	29625	31510	33078	34578	36475
PHILLIPPINES										
AGRICULTURE, HUNTING, FORESTRY & FISHING	9153	9450	9227	9450	9785	10083	9971	10343	10790	11013
MINING & QUARRYING	846	769	769	692	692	616	577	616	616	616
MANUFACTURING	10116	10327	10580	9821	9062	9147	9779	10664	11339	11507
ELECTRICITY, GAS & WATER	473	520	568	615	662	804	899	946	994	1041
CONSTRUCTION	3004	3119	2965	2272	1656	1309	1540	1656	1887	2003
WHOLESALE & RETAIL TRADE & HOTELEERING	6422	6624	7028	7130	7130	7231	7635	8090	8495	8798
TRANSPORT, STORAGE & COMMUNICATION	2306	2399	2445	2306	2306	2352	2445	2537	2675	2768

Table 3 (*Contd.*)

INDUSTRY	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
COMMUNITY, SOCIAL & PERSONNEL SERVICES	4730	4866	5064	4025	3571	3827	4072	4752	5070	5351
NOT ADEQUATELY DEFINED	2262	2329	2362	2129	2029	1996	2029	2129	2262	2329
TOTAL	39312	40403	41008	38440	36893	37365	38947	41733	44128	45426
SRILANKA										
AGRICULTURE, HUNTING, FORESTRY & FISHING	1279	1319	1398	1297	1418	1428	1343	1378	1339	1457
MINING & QUARRYING	34	32	39	46	45	62	76	98	122	133
MANUFACTURING	801	796	773	908	964	1022	1058	1084	1119	1223
ELECTRICITY, GAS & WATER	82	90	91	102	110	119	123	127	129	141
CONSTRUCTION	432	422	425	430	440	473	500	508	512	516
WHOLESALE & RETAIL TRADE & HOTELEERING	755	881	952	1022	1070	1123	1164	1196	1225	1280
TRANSPORT, STORAGE & COMMUNICATION	496	510	563	631	642	657	669	673	665	691
FINANCIAL, INSURANCE, REAL ESTATE & BUSINESS SERVICES	149	189	201	221	238	247	262	278	295	313
COMMUNITY, SOCIAL & PERSONNEL SERVICES	326	329	331	335	340	347	361	355	401	416
NOT ADEQUATELY DEFINED	479	498	525	548	542	567	580	570	579	590
TOTAL	4833	5066	5298	5540	5809	6045	6136	6267	6386	6760
THAILAND										
AGRICULTURE, HUNTING, FORESTRY & FISHING	5185	5343	5580	5892	6256	6274	6261	6900	7333	6882
MINING & QUARRYING	1141	1207	1193	1424	1479	1466	1575	1911	2301	2569
MANUFACTURING	7007	7185	7789	8315	8265	9157	10377	12120	13904	16029
ELECTRICITY, GAS & WATER	576	660	722	789	869	962	1079	1225	1463	1653
CONSTRUCTION	1798	1786	1986	2207	2092	2032	2303	2793	3543	4251
COMMERCE	4842	4790	5063	5455	5638	5941	6710	7720	8970	9965
TRANSPORT, STORAGE & COMMUNICATION	2106	2318	2504	2763	2875	3081*	3337	3695	4118	4572
SERVICES	3676	3893	4272	4416	4625	4782	5306	5887	6385	7497
NOT ADEQUATELY DEFINED	3823	4212	4570	4925	5252	5505	6111	6659	7112	7540
TOTAL	30154	31394	33679	36186	37351	39200	43059	48910	55129	60958

* Includes 'Not Adequately Defined' Category.

TABLE 4 : GDP PER PERSON AT 1985 US DOLLARS

INDUSTRY	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
BANGLADESH										
AGRICULTURE, HUNTING, FORESTRY, FISHING	340	356	364	375	371	376	370	360	349	368
MINING, QUARRYING & MANUFACTURING	550	542	526	543	569	573	605	597	602	632
ELECTRICITY, GAS & WATER	658	763	1141	1201	1251	1377	1647	1875	2368	2447
CONSTRUCTION	1333	1353	1281	1508	1659	1654	1732	1906	1959	2043
WHOLESALE & RETAIL TRADE & HOTELEERING	442	409	421	406	412	420	428	433	445	452
TRANSPORT, STORAGE & COMMUNICATION	1380	1404	1475	1507	1550	1571	1707	1735	1773	1823
FINANCIAL, INSURANCE, REAL ESTATE & BUSINESS SERVICES	1804	1648	1525	1580	1818	2250	2327	2314	2294	2273
COMMUNITY, SOCIAL & PERSONNEL SERVICES	166	146	175	159	207	245	258	273	287	303
NOT ADEQUATELY DEFINED	1314	1345	1381	1420	1449	1500	1547	1629	1675	1724
TOTAL	480	485	496	509	521	534	546	551	553	576
INDIA										
AGRICULTURE, HUNTING, FORESTRY & FISHING	351	340	370	364	358	346	341	386	392	401
MINING & QUARRYING	2847	3061	3020	2955	2993	3278	3261	3404	3425	3410
MANUFACTURING	978	996	1047	1067	1061	1086	1114	1155	1182	1212
ELECTRICITY, GAS & WATER	2771	2765	2780	2872	2913	3007	3036	3177	3262	3302
CONSTRUCTION	2387	2149	2171	2128	2112	2058	2014	1998	1948	1921
TRADE & COMMERCE	1342	1345	1343	1329	1364	1374	1367	1419	1405	1434
TRANSPORT, STORAGE & COMMUNICATION	1328	1335	1368	1436	1504	1545	1602	1666	1741	1772
OTHERS	1361	1436	1474	1545	1615	1697	1785	1877	2035	2106
TOTAL	659	662	698	707	718	728	741	797	824	848
JAPAN										
AGRICULTURE, HUNTING, FORESTRY & FISHING	6494	6980	7277	7743	7911	7941	8396	8327	8816	9167
MINING & QUARRYING	45211	48118	46144	43272	42155	44901	43347	45509	43276	47714
MANUFACTURING	23419	24204	24986	26815	28404	27343	29034	31381	33526	35612
ELECTRICITY, GAS & WATER	100817	108131	115801	118283	128256	130793	134804	145221	152901	171471
CONSTRUCTION	21403	20994	19529	19587	20205	21025	23388	25868	27239	28652
WHOLESALE & RETAIL TRADE & HOTELEERING	24709	25551	26420	26848	27951	28552	29158	30218	31371	33600
TRANSPORT, STORAGE & COMMUNICATION	21004	21230	22356	23866	25185	25513	26183	27770	29386	30717
FINANCIAL, INSURANCE, REAL ESTATE & BUSINESS SERVICES	83061	82335	85120	89689	93610	97717	102749	107661	112905	112542
COMMUNITY, SOCIAL & PERSONNEL SERVICES	8102	8059	7992	7943	7867	7731	7613	7481	7335	7183
NOT ADEQUATELY DEFINED	287368	246678	212914	183375	156554	132850	112021	95837	80923	66856
TOTAL	21173	21618	22120	22987	23970	24096	25108	26427	27639	28875

Table 4 (*Contd.*)

INDUSTRY	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
REPUBLIC OF KOREA										
AGRICULTURE, HUNTING, FORESTRY & FISHING	2209	2499	2835	2941	3213	3540	3476	3952	4132	4162
MINING & QUARRYING	9962	8966	9519	9874	10300	11209	11131	11121	10428	9355
MANUFACTURING	6215	6327	6965	7798	7969	8994	10190	11028	10908	11288
ELECTRICITY, GAS & WATER	36893	38623	49159	60808	68369	84955	94595	103015	112424	130738
CONSTRUCTION	6409	7132	8115	8042	7883	7767	8217	8447	9149	10560
WHOLESALE & RETAIL TRADE & HOTELEERING	3838	3978	4179	4340	4519	5068	5601	5983	5943	6231
TRANSPORT, STORAGE & COMMUNICATION	8999	9075	9403	100065	10047	10505	11299	12024	12576	13381
FINANCIAL, INSURANCE, REAL ESTATE & BUSINESS SERVICES	13790	16447	16166	15308	15413	14893	15218	15738	15363	14752
COMMUNITY, SOCIAL & PERSONNEL SERVICES	4377	4503	4589	4622	4690	4828	4969	5171	5379	5610
TOTAL	4818	5101	5825	6031	6319	6942	7586	8229	8481	8957
PAKISTAN										
AGRICULTURE, HUNTING, FORESTRY & FISHING	573	589	552	603	629	640	647	681	689	714
MINING & QUARRYING	1593	1698	1850	2257	3003	3471	4185	4721	5557	6469
MANUFACTURING	1691	1742	1809	1882	1947	2015	2133	2134	2171	2210
ELECTRICITY, GAS & WATER	3514	3016	2756	2272	2040	1807	1689	1535	1408	1247
CONSTRUCTION	1086	1037	1028	1104	1155	1275	1317	1315	1337	1372
WHOLESALE & RETAIL TRADE & HOTELEERING	1566	1649	1676	1818	1885	1941	2054	2102	2124	2169
TRANSPORT, STORAGE & COMMUNICATION	2059	2151	2352	2388	2477	2560	2569	2383	2457	2577
FINANCIAL, INSURANCE, REAL ESTATE & BUSINESS SERVICES	9629	9953	10252	10523	10943	11325	11634	12033	12396	12797
COMMUNITY, SOCIAL & PERSONNEL SERVICES	651	693	721	717	730	743	747	778	771	758
NOT ADEQUATELY DEFINED	1452	1619	1829	1898	1928	1945	2000	2029	2053	2090
TOTAL	965	1007	1021	1081	1122	1156	1197	1222	1242	1271
PHILLIPPINES										
AGRICULTURE, HUNTING FORESTRY & FISHING	1260	1284	1239	1253	1281	1304	1273	1304	1344	1355
MINING & QUARRYING	12730	11329	11092	9773	9569	8340	7648	7995	7827	7664
MANUFACTURING	8126	8384	8681	8143	7594	7747	8370	9225	9913	10167
ELECTRICITY, GAS & WATER	12302	13367	14432	15444	16431	19724	21798	22671	23545	24371
CONSTRUCTION	8166	8655	8399	6570	4888	3944	4737	5200	6048	6554
WHOLESALE & RETAIL TRADE & HOTELEERING	5597	5574	5710	5592	5399	5287	5389	5513	5589	5589
TRANSPORT, STORAGE & COMMUNICATION	4278	4430	4495	4220	4200	4264	4413	4558	4784	4928
SERVICES	1910	1928	1968	1535	1336	1405	1467	1679	1758	1820
NOT ADEQUATELY DEFINED	14274	14970	15464	14198	13782	13810	14299	15282	16538	17344
TOTAL	2535	2530	2487	2254	2087	2034	2035	2088	2107	2064

Table 4 (*Contd.*)

INDUSTRY	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
SRILANKA										
AGRICULTURE, HUNTING, FORESTRY & FISHING	682	701	742	686	748	752	705	722	700	759
MINING & QUARRYING	1006	861	954	1023	910	1140	1271	1491	1688	1673
MANUFACTURING	1960	1912	1822	2101	2190	2279	2315	2329	2360	2531
ELECTRICITY, GAS & WATER	5127	5345	5134	5466	5600	5754	5650	5541	5347	5551
CONSTRUCTION	3225	3070	3013	2971	2963	3104	3198	3167	3110	3055
WHOLESALE & RETAIL TRADE & HOTELEERING	1726	1967	2075	2174	2222	2277	2304	2311	2311	2357
TRANSPORT, STORAGE & COMMUNICATION	2485	2528	2760	3060	3079	3117	3139	3123	3053	3137
FINANCIAL, INSURANCE, REAL ESTATE & BUSINESS SERVICES	2617	3057	2994	3031	3006	2872	2805	2741	2678	2617
COMMUNITY, SOCIAL & PERSONNEL SERVICES	555	550	544	541	539	540	552	534	592	604
NOT ADEQUATELY DEFINED	1297	1327	1376	1413	1375	1416	1425	1378	1377	1380
TOTAL	963	998	1031	1065	1103	1133	1135	1144	1150	1201
THAILAND										
AGRICULTURE, HUNTING, FORESTRY & FISHING	304	307	313	323	335	328	320	344	358	328
MINING & QUARRYING	12303	12935	12706	15073	15559	15327	16366	19735	23616	26204
MANUFACTURING	4971	4772	4843	4841	4505	4672	4957	5420	5822	6283
ELECTRICITY, GAS & WATER	8494	8897	8898	8890	8951	9059	9290	9642	10527	10874
CONSTRUCTION	4803	4467	4651	4839	4295	3906	4145	4706	5590	6279
COMMERCE	2837	2641	2627	2664	2592	2570	2732	2958	3235	3382
TRANSPORT, STORAGE & COMMUNICATION	4764	5011	5173	5455	5425	5556	5751	6085	6481	6877
SERVICES	1716	1722	1791	1754	1741	1705	1793	1885	1937	2155
NOT ADEQUATELY DEFINED	6017	6416	6736	7022	7241	7338	7872	8288	8550	8753
TOTAL	1224	1234	1281	1331	1329	1348	1431	1571	1710	1826

Energy Audit in Ceramics Industry

NPC Energy Management Division

A wide range of ceramics products are manufactured in India—acidic and basic refractories, electrocast refractories, silicon carbide, zircon/zircon multite, white wares, electro-porcelains such as HT and LT insulators, antenna rods, sanitarywares, glazed and unglazed tiles and an assortment of other products. The units are spread throughout the country and encompass the small (cottage), medium and large scale sectors. A broad spectrum of technologies, primitive on the left and state of art on the right could be found in the Indian ceramic sector. Electro-porcelains and sanitary wares are the two major sub sectors that have been selected for an indepth analysis in this report.

Process Flow

The production process starts with procurement and storage of raw materials which include various types of clays, quartz, feldspar, dolomite, gums etc. The basic process for manufacture of a ceramic product comprises the following steps:

Raw material preparation—grinding, mixing etc.
Shaping, turning or casting to produce greenware
Firing in kilns
Inspection and testing
Packing and despatch.

Apart from these basic steps in the manufacture, specialised intermediate processes are also necessary. Barring minor variation, the equipment used and the process employed by the electro-porcelain and sanitaryware industry are, more or less, similar.

Energy Use Pattern

Firewood, coal, furnace oil, LDO,HSD kerosene, LPG and electricity are the various sources that meet the energy requirements of both these sub-sectors. The energy costs account for around 25 per cent of the total manufacturing cost in a ceramic unit. Thermal energy supplies more than 75 per cent of the energy requirements of the plant. An estimated 14,40,000 MKcals or about 0.14 million tonnes of fuel oil equivalent is annually consumed by these sub sectors.

Electro-porcelain

The estimated installed capacity of electro-porcelain insulators in India is 90,000 MT and the average production is 33, 000 MT in the organised sector. The average capacity utilisation is less than 50 per cent. The overall specific energy consumption varies from 10 MKcal/T to 14.6 MKcal/T (table 1).

Table 1 : Overall specific energy consumption in electro porcelain industries

Plant	SEC*M Kcals/MT	%Thermal	% Electrical
EP 1	11.39	89	11
EP 2	12.74	81	19
EP 3	11.92	91	9
EP 4	14.61	98	2
EP 5	12.25	79	21

* Specific Energy Consumption.

The sectorwise energy consumption details for an electro-porcelain plant are given in table 2.

Table 2 : Sectionwise energy consumption of an electro-porcelain plant

Section	% Energy Consumption
Kiln	56 - 57
Drier	4 - 20
Raw material preparation	1 - 9
Greenware preparation	3
Lighting	1 - 3
Compressor	1 - 6
Others	4 - 16

Sanitaryware

According to the report of the sub-committee set up by the Ministry of Industry, the total demand of sanitaryware in 1990 was 1,74,000 MT of which the organised sector met 1,27,000 MT and the small scale industries in the unorganised sector met the remaining demand of 47,000 MT. The overall specific energy consumption varies from 4 million Kcal/Mt to 15 million kcal/Mt. The overall specific energy consumption and percentage share of thermal and electrical energy for some plants are given in table 3.

Table 3 : Overall specific Energy Consumption in Sanitaryware Industries

Plant	SEC* MKcals/MT	% Thermal	% Electrical
SW 1	5.96	93	7
SW2	4.23	95	5
SW3	9.08	94	6
Sw4	15.01	95	5
Sw5	9.76	97	3

* Specific Energy Consumption.

Table 4 presents the sectionwise energy consumption details for a sanitaryware plant.

Table 4 : Sectionwise energy consumption of a Sanitaryware Plant

Section	% Energy Consumption
Kiln	75 - 79
Raw Material	4
Slip casting	1 - 3
Mould House	1
Compressor	1
Lighting	1
Others	0 - 14

Energy Conservation

Energy audit studies in various ceramic units have revealed a substantial potential for conserving energy and reducing the energy bill (table 5). Several units have already implemented many energy conservation schemes such as waste heat recovery, and efficient combustion systems. The following are the areas which may offer such opportunities:

- House keeping measures
- Short-term measures such as preheating combustion air, load and power factors improvement and waste heat recovery schemes, improvement of capacity utilisation.
- Long-term measures such as upgrading kiln technologies and controls etc.

Table 5: Energy conservation opportunities

Measures	Possible energy savings (%)
Short & Medium term measures	
Ceramic veneering of intermittent kilns	4
Kiln car weight reduction	10
Optimum loading of kilns	15
Excess air control	Varies with plant
Waste heat recovery	
— for preheating combustion air	5
— to meet drier requirements and other thermal requirements in plant	Varies with plant
Load factor and power factor improvement	-do-
Replacement of V-belt with modern flat belt	5
Optimum loading of pulverisers	Varies with plant.
Rationalisation of illumination systems	
— Electronic Ballast for FTLS	Varies with plant
— Replacement of lamps with energy efficient lamps	
Replacement of oversized motors	-do-
Rationalization of compressed air systems	
— Reduction in working pressure	9
Long term measures	
Re-design or replacement of	
— muffle type of kilns with direct fired kilns	20
— peroidic kilns to shuttle kilns	50
Modernisation of kiln technology to incorporate features such as, micro-processor based controls, topjet firing a sweep firing, pulsating firing, high velocity burners etc.	20-30
Reduction of rejects by measures such as modernisation of material handling systems	—

The implementation of energy conservation measures by the plants in both the sub sectors could save about 0.023 million tonnes of fuel oil equivalent every year. There is a saving potential of 20 per cent in electro-porcelain industries, and about 10-15 per cent in sanitaryware industries. The short-term and medium terms measures are technoeconomically feasible with payback period ranging from 4 months to 2 years.

Compiled by
H.R.Prabhu & S.Gopinath

Pollution from Hotmix Plants

NPC Research Division

Hotmix plants are engaged in production of vital road construction materials and are mostly located near the stone crushers. These plants produce two types of products which are used in laying roads, namely, (a) Macadome having a raw material composition of 60 per cent above 20 mm gravels, 30 per cent 10 mm gravels, 10 per cent stone dust and about 4 per cent bitumen. (b) Dense Asphalt Concrete (DAC) with a composition of 60 per cent 10 mm gravels, 5 per cent lime, 35 per cent stone dust and about 6 per cent bitumen.

A typical hotmix plant comprises a raw material storage yard, material handling equipments, oil-fired rotary kiln, bitumen storage-heating pumping system. The manufacturing process consists of addition of stone and gravel in a certain proportion depending on the type of product in an oil-fired rotary dryer. The raw materials are then heated upto 150°C by flue gases generated during oil (usually LDO) combustion in the burner attached to the feeding end of the dryer. The heating is usually done cocurrently. Lime is added in the middle of the dryer and the molten bitumen at the other end. The hot material is mixed with hot bitumen and the resulting product is discharged through a conveyor belt into the truck. The dust laden hot flue gases are passed through a battery of cyclones and discharged into a stack with an exhaust fan. A flow diagram of a typical hotmix plant is shown in figure 1.

Status of Pollution

Hotmix manufacture is a pollution intensive process. NPC carried out a number of pollution monitoring studies in hotmix plants in the Northern India.

Air Pollution

Source Emissions : The single major air pollutant in hotmix plant is particulate matter (dust) generated during heating of raw materials and by rotary motion of the dryer. The quantum of emissions in the stack depends on the proportion of stone dust in the raw material and the performance of the cyclone.

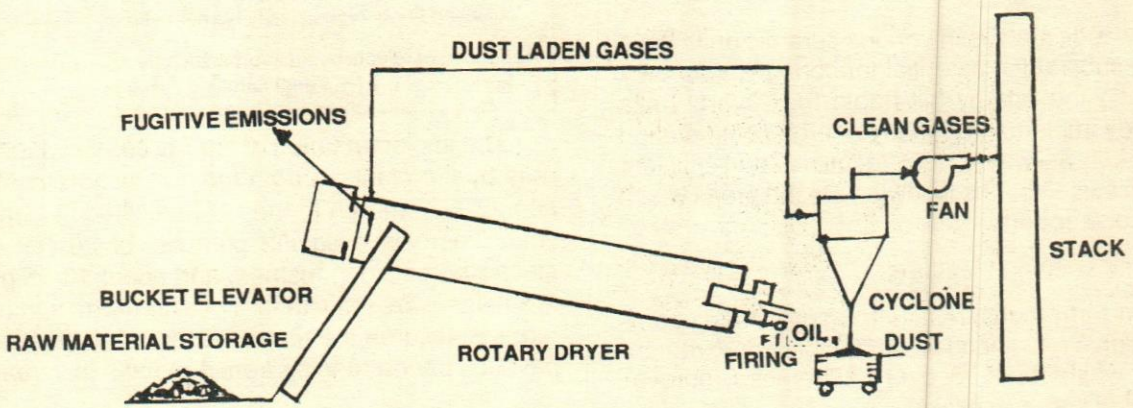

FIG. 1. FLOW DIAGRAM OF A TYPICAL HOTMIX PLANT

Fugitive emissions are mainly,

Dust escaping through the gap at the rotary dryer feeder end

Escape of toxic bitumen vapours into the atmosphere from the bitumen heating tank.

The dust emissions at the rotary dryer feed opening is generally minimized by keeping the gap as small as possible.

Since water is not used in hotmix plants, no water pollution is generated. There is no significant solid waste generation also.

The existing pollution emission levels in a few Hotmix plants are given in Table 1. A typical particle size distribution in a Hotmix plant is given in Table - 2.

Although all the hotmix plants are equipped with control system (usually cyclones), the dust concentration in the flue gases exceed greatly the pollution standard of 1200 mg/Nm^3 (specified by CPCB). In most of the units, the performance of the cyclones is far from satisfactory. It is difficult to meet the stipulated standards even with the best performing cyclones as the bulk (40-60%) of the dust size falls below 10 micron. An additional control equipment — either a bag filter or wet scrubber is usually recomended to meet the environmental standards of 1200 mg/NM^3.

Table 1 : Pollution Emission Levels from Hot Mix Plants

Unit Ref	Production T/Hr	Flue Gas Composition, % Co_2	O_2	CO	Gas Temp. °C	Gas Flow Rate AM^3/Hr	NM^3/Hr	Dust Concentration Mg/NM^3
A	35	7	13	Neg	183	2900	1480	85000
B	42.5	7.6	11.8	Neg	118	4860	3320	105000
C	N.A	4	15	Neg	62	2550	8000	8000
D	30	6	14	Neg	60	5000	4100	21500
E	N.A.	9.2	11.6	Neg	170	13900	8740	13250

Legend

Neg. — Negligible

AM^3/Hr — Flue gas flow rate at the actual temperature

NM^3/Hr — Flue gas flow rate at normal conditions i.e. 25°c & 750 mm Hg.

Table 2 : Typical Particulate Size Distribution (PSD) For Hot Mix Plant

Size (micron)	> 1	> 2	> 5	> 10	> 15	> 20	> 30
%	81.7	75.5	64.8	54.7	48.1	43.3	36.2

Compiled by
R. Suryanarayanan
N. A. Patil

News & Notes

BENCHMARK SETTING

Business benchmarks are needed for four different tasks:

Diagnosis For a realistic assessment of your performance you must have standards of comparison. Is a 10% profit margin good or bad for someone in your position in your industry? What about working capital levels? or marketing, overhead levels, or sales growth rate?

Target Setting A target should include an element of "stretch". How far can you stretch before managers begin to break?

Tracking Which ratios should you watch to pick up unpredicted problems—and when should you start to worry?

Forecasting Often a specific number is needed to make a particular decision. If there is considerable uncertainty, a range of outcomes, with associated probabilities, is more useful than a single guess about future performance.

Business benchmarks are traditionally based on one of the following :

Corporate Averages. If you use these, any strategic business unit (SBU) beating the company average can relax, even if it is in a situation with great opportunities for profits and growth. Many corporations are so diverse that averages are meaningless: some managers can never hope to reach the average, whilst others can do it and spend every afternoon on the golf course.

Industry Standards. The fact is that within any industry there is great diversity between different operations, and many fortunes have been lost in vain attempts to copy successful competitors. A good strategy for the market leader is almost always bad for followers.

Recent History. Analysis of trends is an important part of a strategic audit. However, just as it is inadvisable to steer a car by looking in the rear-view mirror, it is dangerous for businesses in a changing environment to assume that yesterday's ratios apply. You can't assume that any improvement is a success, or any worsening a failure.

Cost of Capital. Many companies put a lot of effort into calculating their corporate cost of capital, and adjusting it for each SBU according to business risk. Business that beat their cost of capital are preferred to those that don't; in practice, though, the variation in cost of capital across most portfolios is a small fraction of the range in performance. A business earning 35% does not need to calculate its C.o.C. to know it is beating it, and one earning 5% knows it is falling short. But the managers of both should want to know whether they could really be doing better.

PIMS Approach to Business Benchmarks

PIMS Par Benchmarks are based on real evidence about what affects spending or performance across 3000 businesses. They quantify the effects of customer complexity or innovation on marketing; or the effects of competitive position on sustainable margins. They tell you what's normal for your business. Par benchmarks only include factors whose effects are stable over time. For example, the par ROI system explains 70% of the wide variance of ROI performance in terms of thirty factors which measure market forces, competitive position, and value adding structure. PIMS par benchmarks are not just theoretical ideas. They have been developed to answer questions posed by managers at a range of levels in all sorts of businesses.

Business Benchmarks for Target-setting and Forecasting are based on careful analysis of businesses "like yours". With over 16000 years of experience in the PIMS database, it is almost always possible to find a range of businesses that have faced the challenges you face today. The process of selecting look-alikes requires a structured discussion with business managers, defining the key parameters of mar-

kets, technology, and competitive position. Looking at the range of performance achieved by similar businesses is crucial for target setting. Xerox, for example, used PIMS to build a company-wide programme of salesforce productivity improvement by identifying what winners achieve and how they do it. A major glass company used this approach for forecasting what would happen while negotiating a competitor acquisition. Assessing how much of the combined market shares could be held was crucial to the success of the deal, and PIMS benchmarking for share retention was an important input to valuation.

Business Benchmarks for Tracking need to gauge the impact of your internal improvement programmes as well as changing market conditions. A 1% improvement in employee productivity may be excellent in a declining market—but a disaster if demand is strong. PIMS tracking benchmarks look at year-to -year changes inside and outside your business, and indicate whether the shifts in performance are "normal" or running you into trouble. A textile company that used this approach quickly identified its major problem as a failure to improve material yield as competition intensified.

IFC Project Team, National Productivity Council, New Delhi 110003

BARRIERS TO ENERGY EFFICIENCY

The efforts to enhance efficiency of energy use increase as the relative price of energy rises and as technology becomes more energy-efficient, making additional energy conservation investments more attractive. This occurred in the 1970s when rapid technological improvements were triggered by oil price rises although in Asia the capital constraints of the developing countries hindered energy efficient measures to some extent. There are a number of constraints, however, that create barriers to the efficient allocation of energy resources in both the public and private sectors:

Technical barriers result from a lack of skills and equipment necessary to determine the returns on energy conservation investment. Even if the returns are known, the design skills required to carry out the retrofitting of an inefficient plant may not be available.

Prices which do not reflect economic scarcity (both for energy and alternative factors of production) and environmental externalities which are not reflected in market prices pose economic barriers to efficient energy use.

Financial barriers may be due to a number of factors including investment bias in favor of larger energy producers as against small-scale producers, the high risk associated with retrofitting investments, high interest rates or lack of access to capital, especially foreign exchange (which are faced by energy consumers as compared to capital availability for energy producers).

Institutional weaknesses due to the lack of coordinated energy conservation efforts on the part of government. The absence of a central agency results in poor coordination of energy conservation efforts which tend to be fragmented among various ministries.

Asian Development Bank
Integrated Energy Environment Planning
Towards Developing a Framework
May 1992

EMPLOYEE INVOLVEMENT PROGRAMMES

It is easy to see the appeal of employee involvement programmes (EI) for managers, especially those at the top. EI can improve the adaptability and the flexibility of the organization. EI's appeal to lower-level employees, unionized workers and direct supervisors, however, is more ambiguous. Workers may resist greater involvement in decision-making because they view it as an attempt by management to speed up production or otherwise to get them to increase work effort without a corresponding increase in compensation. Unionized workers may also view it as a threat to collective bargining. First line and mid-level supervision may resist EI because they view it as an affront to their authority which, over the long term, may make them obsolete if workers are able to manage themselves. All parties may be opposed simply because it is easier and more comfortable to maintain established relationships and practices than to change them.

Although this resistance may be common, it can be overpowered by other, more immediate, concerns. If a crisis exists and the company or the plant is faced with the prospect of closure or significant reduction in force, the workers may accept new approaches to employee relations as necessary to retain their jobs and maintain their incomes. If a new plant is being constructed, those hired may be more willing to accept non-traditional strategies since there is no prior history to suggest alternative approaches. However, in established facilities with growth or at least no immediate threat to solvency of operations, new strategies may be far more difficult to introduce. In the absence of a crisis situation,

or the flexibility of a new work environment, both hourly workers and front-line supervisors may first have to be convinced to do things differently.

Thus lack of compelling incentives for employee participation in an EI programme may undermine attempts to bring about organizational changes at the outset. Moreover, there may be differences among employees in both how much they want to be involved in decision-making, and in how productive they feel their involvement will actually be. Generally, the research on employee involvement indicates that programmes that are implemented with the objective of improving decision making, information sharing, or skill utilization tend to be more effective than those with the objective of enhancing good will or employee motivation. This suggests that employees who are able to contribute new information or diverse perspectives may be the most desirable candidates for participation in an employee involvement programme. In fact, most employees may either already have the ability to contribute by virtue of their established specialized skills, or may develop it through programmes like cross-training such as the one at General Electric's Salisbury, N.C. Plant.

In addition to these considerations, the involvement experience should be more meaningful, and therefore more effective, for employees who either possess the skill or the desire to expand their participation in decision-making. Once involved, however, these employees will often have expectations of real influence. The EI programme and flexible work system at the Toyota General Motors joint venture in Fremont, California (NUMMI), for example, has been touted as a radical (and successful) new approach to work design that enhances both employee influence and organizational flexibility. However, it has also been criticized by some employees because it does not live up to its promise of real employee control, but instead may even promote further structure and confinement on the job.

Once an EI programme is operating, attention also must be paid to ensuring that personal incentives for involvement remain positive. Employees may easily become discouraged if their initial expectations are not met or if their decisions are not carried out. Creating a positive environment for participation is thus critical to the success of any strategy which seeks to enhance employee involvement in the decision-making process.

Roger S. Ahlabrandt
Carrie R. Leana & Audrey J. Murrel,
Long Range Planning
Vol. 25, No. 5. 1992.

IFC IN INDIAN SOFTWARE INDUSTRY

"The productivity of the Indian software industry is comparable to European and US standards", according to a pilot study carried out by the Interfirm Comparison Team of the National Productivity Council under the guidance of Mr. H. Gierszal of Industrial Informatics, Germany. However, there is ample scope for improving the quality levels. This calls for vigorous efforts to introduce ISO 9000 standards. These were the views echoed by the Indo-German team at a meeting at India International Centre, New Delhi, on the basis of a survey of Indian Software industry carried out at Madras, Bangalore , New Delhi and Bombay. This survey is the first of its kind in India. It comprised the following aspects:

* Quality of the software development process (the so-called process quality)
* Product quality
* Productivity

For the assessment of productivity and quality the appropriate metrics according to the methods of the Software Productivity Research Inc. (SPR) were applied. The assessment of process quality was carried out by using the BOOTSTRAP method, the reference model which is based on the international standards ISO 9000 - 9004 . The comprehensive in-house assessment has taken 5 days per company. While assessing process quality, several organisational and methodical aspects of software development were examined. Though Indian companies have good scores in many areas related to detailed design, coding and testing, there is a lot to be done in formalising and streamlining organisational aspects.

The results of the assessments of 25 completed projects (sample size) have been in many cases above US and European averages. This could be explained by different accounting procedures, complexities and duration of projects etc. For a more accurate comparison such surveys will have to be conducted in more companies and on a periodic basis. The findings of a more comprehensive survey would assist the software industry to further improve both productivity and quality thereby strengthening their global competitiveness.

IFC Project Team,
National Productivity Council,
New Delhi 110003.

NEW PATTERNS OF INDUSTRIAL RELATIONS IN EUROPE

Europe is going through a process of important transformations. The reshaping of economic, social and political structures raises questions on its effect on the characteristics of European Industrial Relations. In close collaboration with researchers from the Massachusetts Institute for Technology and Harvard University, the ECWS organised a workshop on the emergence of new patterns of Industrial Relations in Europe. American and European industrial relations scholars were invited to elaborate on their perceptions and hypotheses concerning the current changes in Europe. The central hypothesis of the workshop stated that the transformations are mostly rooted in a set of changes in the organisation of economic life. This process is described as a *double shift*. On the one hand, the most important level of decision-making is downgraded to sub-national levels, e.g. sector or company level. On the other hand, an upward shift takes place towards supranational levels. The workshop focused on the effect these changes will have on union strategies. Bearing in mind the different types of industrial relations in Europe, unions will be confronted with new challenges in the near future following the double shift.

Two papers were presented during the workshop. The first concentrated on the upward shift and stated that unions are facing a new situation which contains threats to their very survival. Without organisational and strategic innovation, they cannot effectively cope with the shift of economic policy capacity towards European community Institutions.The second contribution discussed the downward shift and the resurgence of the local union. It argued that unions adapt best to the new challenges in countries where local structures are able to negotiate and participate in central problems. The current difficulties for unions result from a mismatch between nationally oriented federations, dominated by the national industrial unions, and the company level challenges generated by the process of industrial reorganisation of the '70s and '80s. The current problems of unions are due to the subordinate role of locals in a nationally dominated union structure.

European Centre for Work and Society, Oct. 1992.

YOUR CUSTOMERS PLEASE

The ability to build customer loyalty and confidence is the most important characteristic of successful front-liners, according to a study by Learning International. The study categorised 90 behaviours customers see, feel, and hear when doing business with people who excel at customer care. Some of the ways in which outstanding service providers demonstrate these skills include:

• Building customer loyalty by making follow-up calls regularly—and when promised—to make sure customers are satisfied * looking for ways to make things better even if problems don't exist * sending information to interest customers in products or services they haven't tried * providing information and special resources to help with complex problems * using good judgement in modifying policies and procedures to accommodate customer requests.

• Empathizing by making sure customers are not kept waiting long * allowing customers to take their time explaining needs * showing a willingness to see things from the customer's point of view * remaining calm with customers who just want to complain * respecting customer's time and avoiding excessive small talk * calling back promptly with information not immediately available when requested.

• Communicating effectively by clearly explaining technical issues to nontechnical people * speaking clearly and with poise * promptly providing accurate, reliable information * knowing when and how to ask questions to get the information needed from customers.

• Handling stress by staying organised and responding to customers courteously even when other customers are waiting * dealing courteously with customers who refuse advice or won't follow directions assuring irate customers that a situation can be resolved without "seeing the manager" * defusing customer's hostility by acknowledging their feelings and responding patiently * keeping customer anger from having a negative effect on self-esteem.

• Listening actively by being patient and not interrupting * clarifying and confirming that customers understand what is said. Demonstrating mental alertness

by listening to customers' descriptions of situations and assessing implications quickly and accurately * learning by asking questions to better understand customer situations.

Productivity Digest
April 1992

AN AGENDA FOR SELF RELIANCE

India is already the third largest debtor among developing countries, With its external debt currently estimated at 75 billion dollars, and it is set to hit the 100 billion dollar mark before the turn of the century, leaving the burden of repayment to coming generations. It is in this grim setting that eminent economist Dr I.G. Patel has called for "Freedom from foreign debt", within the next 15 to 20 years to restore the nation's elan and self-esteem. A clear, explicity stated and time-bound policy to secure that freedom becomes a matter of the highest priority, he says.

Dr. Patel recognizes that freedom from foreign debt is not an absolute concept and has to be approached in stages and in a certain sequence. The first requirement is the elimination of the current account deficit, which would put a stop to further increase in indebtedness. Until then, debt will continue to rise though, hopefully, at a slower rate. While direct foreign investment should be welcome, there should be no special concessions to attract them in order to cover balance of payments deficits. The only assurance to investors would be about convertibility at the prevailing rate of exchange. Also the temptation to bridge the BOP gap by short-term credits has to be shunned. Once India balances its current account deficit and confidence is restored, we should aim to reduce the debt to foreign governments faster than the debt to international institutions.

Graduated steps towards this goal must be taken even from now on. We should end forthwith the earlier debtor-creditor relationship with erstwhile communist states and do likewise, as soon as possible, with what remains of the legacy of indebtedness to the Gulf countries. We should not be averse to declining future aid from any country with which the aid relationship becomes particularly "Vexatious", especially USA from which we get "rather modest aid and immoderate annoyances". These symbols of self-restraint would set the direction and pace of self reliance and act as focal points for greater discipline. If assumptions underlying the Eighth plan including a current account deficit at not more than 1.6 per cent of GDP are maintained well beyond 1997, our external debt will cease to grow and we can look forward to current account balance by the end of the century. The crucial point is that export must increase much faster than imports. The current savings rate of 21 per cent of GDP must rise by 2.4 per cent points by 2,000 AD and the efficiency of industry and agriculture and services must steadily increase by exposing them to competition within and abroad. Also we need a sound budgetary and monetary policy which keeps our economy competitive.

Beyond the realm of economic policy, Dr Patel sees the vital necessity of changes in all aspects of national life, in policy as much as in economy, in social attitudes, and in foreign policy. Greater efforts are needed to inculcate the spirit of austerity among all classes. A new work ethics of efficiency and accountability has to be brought about. Labour laws and their adjudication should be in line with the requirements of competition and accountability. Political courage and statesmanship would be needed to reverse the emphasis on "the rights of man and the obligations of the state" fostered by politicians, economists, judges and journalists. Self reliance requires hard decisions.

India International Centre Diary
Oct 1992

AUTOMATING SURFACE INSPECTION

An automatic inspection system, capable of rapidly identifying fabric defects, could soon cut manufacturing and wastage costs and lead to major improvements in the quality of textile materials. After its successful development of off-line fabric inspection systems, the British Textile Technology Group (BTTG) is now developing a system that will work on a production line, automatically alerting the operator to defects. It will also increase the flexibility of a production line by enabling a more consistent and better documented fabric to be manufactured.

The programme is being jointly conducted with ERA (Electrical Research Association) Technology, to introduce automatic surface inspection techniques in other sectors such as leather, paper, printing and footwear. The BTTG is the world's largest independent textile research group, with its roots in the Lancashire cotton industry and the Yorkshire wool industry. The prototype uses image processing techniques based on the British-designed transputer—the computer on chip advanced sensor technology and a specially developed camera interface. The camera passes informa-

tion to the electronic processing system in a similar way to equipment developed for aerospace and defence applications.

A number of defects can arise during manufacture and processing, ranging from yarn defects such as knots to broken threads, missing threads, holes and stains. An on line system would enable manufacturers to respond rapidly by either stopping production and carrying out hand repairs or by making machine adjustments. In addition, a complete fault map could be produced for each batch of fabric in electronic form. This could be used in a number of ways, for example, by automatically marking defects and providing paper print-outs. BTTG and ERA are aiming for a low-cost system that will be sufficiently flexible to suit a wide range of users in the textile industry.

British Commercial News.
November - December, 1992.

SOIL DECONTAMINATION PLANTS ON TEST

The world's first field experiment to test the potential of special plants to decontaminate polluted land is now under way in the UK. A team of scientists at the UK Agricultural and Food Research Council's (AFRC) Rothamsted Experimental Station at Harpenden, near London, has succeeded in developing plants that will grow in soil highly contaminated with heavy metals. Team leader, Dr Steve Mc Grath, reports: "Experiments indicate that the plants will absorb the heavy metals from the soil, eventually leading to decontamination. It is likely that this research will lead to a safe, natural and cost-effective method for dealing with the problem of soil contamination.

Heavy metals such as zinc, cadmium and copper which are present in sewage sludge, can have disastrous effects on the soil microbial population in treated farmland. Over the past few years it has been found that even small concentrations of metals from sewage sludge applied to agricultural land can seriously interfere with soil microbiological activity. *Rhizobium leguminosarum biovar trifolii,* the nitrogen-fixing bacterium that infects clover roots,is particularly sensitive.

In experimental plots of land contaminated with metal, only one strain of soil bug was tolerant to metals, but even in this case it was not able to fix nitrogen with the normal host. Scientists involved in these experiments found it impossible to establish which of the several different metals was responsible for the death of effective strains of microbe. In the light of this, the Rothamsted Experimental Station carried out a series of laboratory experiments in collaboration with London University's Wye agricultural college. In these increasing concentrations of zinc, cadmium, copper and nickel were added separately to soil from the uncontaminated control plot of the experiment. The results showed that adding zinc at 1.3 times the current UK limit for this element in sludge-treated soil, or cadmium at 2.4 times the limit, caused complete death of effective strains of microbe within 18 months. Copper at 1.7 times the limit decreased the number of deaths but did not cause complete elimination, and nickel had no effect.

Most plants at best can only remove small quantities of toxic metals from soil and it is calculated it would take several thousand years by this means to decontaminate Rothamsted's sludge-treated experimental plots. But Dr. Mc Grath's work has given new hope because the team has found that some highly specialised plants, known as hyper-accumulators, can easily absorb much larger concentrations of metals.

The UK research, which is being sponsored by the European Community and carried out in collaboration with Sheffield University in northern England, and Massey University in New Zealand, has shown that hyperaccumulator plants can absorb as much as 10,000 mg zinc for every one-tenth of a kilogramme of dry matter, compared to about 30mg in normal plants. in the case of cadmium, they can absorb 100mg per one-tenth of a kilogramme of soil compared with 1mg normally.

British Commercial News.
Nov.-Dec., 1992

TECHNOLOGY GAP IS SELF-REINFORCING

Developing nations have made considerable gains since the 1960s in terms of basic education and life expectancy, but they lag significantly in the areas of higher learning and technology. The newly released Human Development Report 1992 of the United Nations Development Programme (UNDP) observes that gaps between countries of the North and South in terms of technical education informatics and technological research are particularly disturbing; "The engine of economic progress is technological innovation and increases in human productivity, and this is precisely where the developing countries are being left behind by the rapid strides of the industrial world." This year's report notes, among other things, that:

* The tertiary student enrolment ratio is only 8 per cent in the South compared with 37 per cent in the North. In the least developed countries it is 2 per cent.
* Scientific and technical personnel number only 9 per 1,000 people in the South. compared with 81 in the North.
* Countries in the south appear to have been by-passed by the communications and informatics revolution. Per capita, they have only one eighteenth as many telephone connections, one eighth as many newspaper and one sixth as many radios.
* The South has 80 per cent of the world's people but only 5 per cent of the world's computers.
* Developing countries are responsible for only 4 per cent of the world's research and development expenditure.

These gaps are self-reinforcing, states the report: "The concentration of knowledge in the industrial countries means that further advances also tend to occur there. This gives them a productivity advantage and consequently much higher returns on capital and labour. The higher profit rates in industrial countries enables them to attract yet more capital (even from developing countries) and this facilitates more investment in technology."

The report observes that the gaps are widening because basic scientific and technological information is increasingly being privatized. "The kind of information which used to appear in the public domain is now likely to be patented or copyrighted and available only to those who can pay the price. Even to keep up to date with freely available information now demands higher levels of technology to access computer networks." This "cycle of concentration" is reflected in world trade where OECD nations can meet consumer demand with skill-intensive production at home and import less from the developing world. The developing world's share of world trade fell from 24.8 per cent in 1980 to 19.3 per cent in 1989.

The challenge for developing countries in the coming decade will be to satisfy basic human development needs and invest heavily in human capital formation — particularly in technical and managerial skill: " Unless they acquire greater control over the expanding knowledge industry, the developing countries will languish in the backwater of low-value -added production."

Update Atlas News: No. 16, Spring 1992

THERE'S MONEY IN WASTE

Poverty places severe limitations on the waste disposal options for developing countries, many of which have yet to install sewerage systems, even in their cities. But a common weed which purifies waste water contaminated by excreta, which has a protein content similar to that of soya beans and which can be sold as a cash crop for fattening fish and feeding human populations could transform the environment and health of poor communities throughout Asia and other third world regions.

The plant is *Lemnacaea*, or duckweed, which grows prolifically at temperatures in the range of 15°C to 30°C. In waste waters rich in nitrogen, phosphorus and potassium, the vibrant green plant with its tiny leaves can double its weight every two to four days. An American-based non-profit organization known as the Prism Group has been experimenting with patented duckweed systems in Peru, Mexico, Bangladesh, Egypt and the United States for a number of years, and its Chairman in Bangladesh, Mohammad Ikramullah. has described the plant as "green gold".

In Bangladesh, where 97 per cent of the population is without sanitation services and where half of all surface water is contaminated by faecal matter for half the year, the cultivation and harvesting of duckweed has enormous potential. Mr. Ikramullah reports that waste water treatment systems covered in duckweed can produce crystal-clear water with a phosphorus and nitrogen content of less than 0.5 milligrams per litre within 20 days. During this process, the weed can be continuously harvested to yield one tonne per hectare per day and sold retail for $ 27 a tonne. The harvest can triple average yields when fed to fish, but it can also be dried and added to chicken feed. Prism, Bangladesh has been experimenting with carp raised in ponds where freshly harvested duckweed is the only source of food. The ponds have yielded more than 10 tonnes of carp per hectare per year, compared with just 400 kilograms under traditional aquaculture. At an average price of $ 2 per kilo of fish, the net return is about $ 16,000 per hectare per year.

The United Nations Capital Development Fund of UNDP is currently supporting the introduction of Prism's technology to 10 villages in central Bangladesh. Farm families will be encouraged to channel their waste into derelict ponds surrounding the villages, where it will fertilize the organized harvesting of duckweed by indi-

vidual farmers on one -quarter hectare "plots" sectioned by bamboo poles. Weed production is so vigorous under these controlled conditions that a quarter hectare fed by effluent from about 100 people is about all one farmer can harvest alone. Word of duckweed's versatility and food potential is spreading rapidly. While Mr. Ikramullah believes it is the food of the future for protein-poor nations like Bangladesh, Israeli farmers have been touting it as a food for the wealthy. They are harvesting and marketing it as a salad in health food shops across Europe.

Update,
No. 49, Spring, 1992

EMPLOYEE INVOLVEMENT

SAIL is one of the largest corporate entities on the Indian industrial scene with five major integrated steel plants and four special and alloy steel producing units. The turnover of SAIL was Rs. 9624.75 crores in 91 - 92. The SAIL team consists of over 2,32,000 members spread across the country. Bhilai Steel plant is the flagship of SAIL. Bhilai produces more than a third of the total SAIL output. Its labour productivity of 107 tonnes per man-year in 91-92 is the highest in the Indian steel industry. The Bhilai collective today consists of about 57,000 people.

By the early 80's , SAIL had turned into a sloppy, unmanageable juggernaut, the reasons being:

- The technological lags of the 70's
- Cumulative financial losses.
- Crumbling work culture.

The focus of the SAIL turnaround strategy was the employee. Believing that its 2.3 lakh collective constituted its strongest resource, a number of HRD initiatives were taken. These included the Action series of workshops, the largest communication exercise in Indian Corporate history, followed by other series like perspective for HRM, The Unfinished Agenda and Agenda for Tomorrow.

Employee involvement in SAIL means:

- Collective decision-making and communication
- Sharing and learning
- Thinking and doing it together

These are achieved through Saturday meetings; luncheon interactions; counselling labs; employee suggestion schemes; shop improvement groups ((SIGS); the executive performance appraisal system, unit training: cooperative working (like handling of the canteen by workers; cooperatives) core group system for monitoring implementation of productivity clauses: literacy campaigns; HRD climate survey etc. in the management union relationships instead of the traditional issues like higher wages, bonus etc, the issues discussed are work norms, manning standards, employment levels, subcontracting practices, environmental hazards and recruitment patterns.

CII HRD Newsletter
Sept. 1992

THE THREE PILLARS OF 5S ACTIVITIES

The key to 5S activities is the one-at-a-time, steadfast implementation of an activity for a specific goal. When viewed as a whole. These activities fall into three categories, — the three pillars supporting 5S activities. The first focus is on the disciplined work environment. The purpose of this goal is to focus on raising the basic management level through 5S practices and transforming the quality of human behavior. In a nutshell, the goal is to see that everyone abides by the rules once they are defined. Thus, of central importance are the ways in which everyone carries out his or her duties and participates in activities. Of equal importance are the training methods that allow each individual worker to be responsible for his or her assigned activities and behavior. The next step is to ensure that the acquired habit of disciplined behavior on the part of every employee will not be forgotten or allowed to disappear. The key to creating a conductive work environment is to clean the smallest elements of the work environment and equipment. By thus radically transforming the condition of the work environment, the workers will be motivated and inspired to renewed awareness.

The third pillar 5S is the creation of a work environment that can be managed by seeing, an idea popularly referred to as management by observation. By improving upon ways to identify abnormal conditions quickly and easily, it becomes possible to create an environment in which anyone in an area can spontaneously help someone else when an abnormal condition occurs. This means prevention of errors, and can be called the Standardization of the 5S's. These activities should be pursued simultaneously to take advantage of their mutual interrelationship.

Asian Productivity Organization,
Total Productive Maintenance, (1990)

Book Review

Marketing and Sales Management by K.R. Balan and C.S. Rayudu, Sterling Publishers, 1991, 299 p, Rs. 60.

The concept of marketing has been changing with time due to social economic changes, innovations in production and designs as well as the dynamic distribution methodology adopted. While tracing the history of marketing the authors reiterate the concept of marketing being fluid. In the present context marketing is more customer oriented than ever before.

While on Sales Management, the authors state that the difference between marketing and selling is more than semantic. Selling focuses on the needs of the seller, marketing on the needs of the buyer. In selling there is preoccupation with the seller's need to convert his product into cash; marketing caters to the needs of the customer by means of the product and a whole cluster of things associated with creating, delivering and finally consuming it.

The authors have integrated the study of marketing and sales management in a thematic presentation of the subject. Under the conventional sales orientation, an engineer designed a product, the manufacturer produced it and then the sales people were expected to sell it. Whereas under the modern 'marketing concept' the whole business process starts with marketing research and sales forecasting to provide a sound, factual, customer-oriented basis for planning all business operations. In other words the marketing man is introduced at the beginning rather than at the end of the product cycle. This is the underlying fact brought out in the book.

To cover all the possible aspects related to the subject the authors have divided the book to cover aspects of Product Planning and Product Policy, Pricing, Distribution Channels, Sales Operation and Promotion, Sales Organization, Management of Salesforce, Handling Orders, Control of Sales operations, Organization for Management Control, the Art of Administration, and Consumerism and Advertising. The authors have no doubt tried to give a comprehensive coverage of the subject matter but have failed to deal with the subject in detail. The various issues tackled just give a basic introductory knowledge of the subject discussed. The book provides useful insights into the marketing jargons, but does not provide serious analysis reading on the subject.

However, the book does have its plus points. It uses live examples to distinguish Sales from Marketing. It also demonstrates how sales management is linked closely with marketing management and how these concepts can be applied to achieve better results—a facet touched by many books on marketing management but not explained. The book could be a handy tool for a sales manager to exeute his job in a creative and effective manner. The various appendices given are most helpful for a front line manager to monitor the movement of the sales force, as well as to allocate his resources in an optimum manner.

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Ecology and the Politics of Survival: Conflicts Over Natural Resources in India by Vandana Shiva, Sage Publications, New Delhi, 1991, 366p, Rs. 250.

Inter-linkages between development and environment are issues being debated at various fora for the last twenty years. Vandana Shiva in her book has clearly brought out the fact that environmental movements of elites from developed countries may worry about the environmental implications of developmental process in the context of global issues such as global warming, acid rain, ozone layer depletion etc., but for the people in developing country like India mere survival of many communities depends on preservation of natural ecosystems. Hence, these communities in the recent past have initiated movements making ecology a political issue for survival.

The work carried out by the author and her colleagues as a part of the United Nations University's Programme on Peace and Global Transformation and presented in this book provides insights into the interlinkages between natural resource utilization and developmental priorities in India. The author rules out the

misconception that poor people cannot be a source of solution to ecologic crisis and they are merely a source of environmental problems. Quoting from ancient Indian philosophy she makes it clear that for the people of India a healthy respect to nature is a part of life. Natural resources were treated in India as common/ community property and accordingly observed and conserved. The conflicts originated in the transformation of these commons to commodities in the developmental projects during the British rule as also after independence.

She argues that only market driven economies are in conflict with people's survival. In the recent past international agencies have been funding developmental activities in environmentally sensitive sectors such as agriculture, forestry and irrigation. Despite the so called environmental guidelines and environmental clearance requirements of these agencies, this has aggravated the problem of local communities whose survival is at stake. The conflict over natural resources in developing countries has now become a global issue. The people's ecology movements in developing countries like India provide an alternate perception of ecology as the politics of survival in the context of natural resources use.

The author has divided her book into three parts. In the first part she describes the inter-linkages between conflicts over natural resources and ecology movement in India. In the second part she provides details about forest conflicts while in the third she discusses conflicts over water resources. The author does not discuss the deteriorating quality of other resources such as air, water and soil as a result of developmental activities. After delineating the conflicts, the author concludes that these conflicts emerge from development interventions which are primarily aimed at commercial exploitation of natural resources. These conflicts can be viewed as conflicts between commercial interests and people's survival on one hand, and nature's economy and market economy on the other. As market cannot solve ecological crisis, contemporary ecological movements are a renewed attempt to establish that steadiness and stability is not stagnation. Balance with nature's essential ecological processes is not scientific and technological backwardness, but scientific and technological sophistication towards which the world must strive if planet earth and her children are to survive.

While the issues discussed in the book are familiar to the environmentalists, the book is an excellent contribution as it supports ecologists' sentiments with scientific data. It provides an insight into the unseen dimension of developmental programmes.

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Economic Development in South Asia by A.E. Granovsky, Agricole Publishing Academy, New Delhi, 1992, 267p, Rs. 300.

This is an English translation of the book written originally in Russian language by a leading Russian expert on economic development in South Asia. The book, as its title suggests, deals with the overall economic development of South Asia. The countries covered are India, Pakistan, Bangladesh, Nepal and Sri Lanka. The period covered comprises the last four decades from the fifties to the eighties. The book is divided into two parts. Part I presents a theoretical approach to economic growth in South Asian countries. It provides an integrated analysis of all the five countries within a common framework and with comparable data. Part II contains five chapters, one for each country. Here a more detailed analysis of country specific data is presented.

The book finds a high degree of diversity in growth patterns of the five countries of South Asia. As the author points out, "India and Brazil, Pakistan and Phillippines, Sri Lanka and Malaysia or Jamaica by principal economic characteristics are much closer to each other than the above mentioned South Asian countries". At the same time the South Asian countries had several similarities also. A major similarity related to the role of domestic vs. external factors and the role of the state in bringing about economic transformation. In contrast to most developing countries, the post-colonial transformation in South Asian countries, despite varying dependence on external capital flows and foreign technology, had a predominantly endogenous character and was based primarily on the development of various forms of national capitalism. The institutional mechanism was based on a mixed economy relying on close interaction of public setor with different segments of private capitalist production. The state had a high level of influence on the economic system and social relations. However, by the mid 70's, most countries of

the region, each in its own way, reached a stage when opportunities for further economic development were considerably restrained states the author.

The book has several distinct features. First, unlike several other books on the subject, this book provides a comparative study of the process of economic development in all the five countries. Second, there is considerable emphasis on theoretical analysis. The author has a marxist theoretical perspective and tries to analyse facts within this framework. As a result, the book has a plethora of usual Marxist jargons. Third, the treatment throughout is analytical rather than descriptive. The author tries to explain the cause-and-effect mechanism of development and its driving forces. Fourth, the analytical framework is quite comprehensive; it includes not only economic but social and political factors also. Fifth, the author relies mainly on Russian sources of studies. It is indeed amazing to know the range of studies on India and other South Asian countries that have been undertaken in Russia.

On the whole, the book is quite informative. It is a very good reference source on the subject. A large number of statistical tables are presented in comparable and compact form. The analysis of facts within a theoretical perspective enhances its utility. However, being a translation, the flow is missing. At several places, the language becomes quite terse and monotonous. The use of very small type print strains the eye.

Unlike several other foreign scholars, the author has been able to understand the complex South Asian reality to a great extent. He, therefore, has succeeded in drawing attention to important aspects and in marshaling facts accordingly. The book is quite useful for scholars of South Asia and economists and social thinkers interested in issues of economic development throughout the world. Policy makers would also find the book informative.

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South-South Trade Preferences. The GSTP and Trade in Manufactures by Hans Linnemann, Sage Publications, New Delhi, 1992, 236p, Rs. 240.

The present study is the ninth volume in the series of studies sponsored under the Indo-Dutch Programme on Alternatives in Development (IDPAD). The book contains eight papers including the Introduction by the Editor. As indicated in the introduction, the book "focuses on Trade Control Measures (TCMs) and their actual and potential use to influence the level of trade between developing countries. The issue at stake here is the extent to which a preferential lowering of tariff and non tariff barriers could lead to enlarged South-South Trade in manufactured products. The policy-induced impediments to trade and the possibility of selectively reducing or removing them are the subject matter of this study.

The second article 'Preferential Trade among developing countries' by P.V. Dijck focuses on 'obstacles to the formation of a preferential trading system ....." (p. 36). The author emphasises that reducing tariff and non tariff bariers to imports, often supposed to be synonymous with trade liberalisation may be inconsequential (p. 37). If the distribution of costs and benefits appears to be a major cause of conflict among partner countries....." then the viability of the prefential trading system may be limited (p.39). The author, however, does not question the desirability of such a system.

In the third article "Towards a Global System of Trade Preferences Among Developing Countries" P.V. Dijck has raised questions regarding the implementation of a Global System of Trade Preferences (GSTP) among Developing Countries (p.55). The author believes that "the impact of the GSTP on the trade performance of developing countries is likely to remain limited in the near future ...." (p.71) because of non-identical stages of development, different socio political system, government interventions in policies etc. In the fourth article, The Syndrome of Protectionism and the Prospects for Trade Liberalisation P.V. Dijck and E. Hoogteijling raise doubt about the implementation of the GSTP (p.75), particularly in view of the vested interests of many governments (p.77).

In the fifth article H. Verbruggen stresses that "the learning-by doing benefits of capital goods production in the South" may be expected to "act as a generator and transmitter of skills and technology among developing countries" i.e., intra south trade (p.142). In view of the fact that this trade flow in capital goods from the south is "dominated by a few countries covering a few product groups" (p,133) the author, without explaining how, pleads for participation by a large number of countries covering increasing product groups.

The sixth article is an echo of the fifth article written by the same author. The author, however, does not go into the measures he might have thought necessary for protecting the domestic producers in developing

countries. In the seventh article 'Commodity Composition of Trade in Manufacturers and South South Trade Potential', C.V. Beers and H. Linnemann argue that the intensity of trade, particularly in manufactures, between any pair of developing countries is conditional upon. among other factors, the degree of correspondence between the export structure of the supporting country and the import structure of the importing country (p.176-177). (p. 195). As shown by the authors. "..... the dominating position of the OECD countries as suppliers of manufactured export products..... is at the core of the whole issue of raising "South-South trade in manufacturers, some further analysis of the possibilities for future substitution is warranted (p.190-191)." The readers may agree with them on this point. In the eighth article, GSTP Tariff Reduction and Its Effects on South-South Trade Flows, by H. Linnemann and H. Verbruggen, the focus is on the impact of a GSTP arrangement lowering import tarrifs.

The point in common in all the articles is that more insight is necessary to understand the implications and consequences of GSTP arrangements. The book is worth reading for all those interested in development economics and trade related economic development of the south in particular.

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Management of Irrigation Facilities in Asia and the Pacific, Asian Productivity Organisation (APO), Tokyo, 1991, 321p, Price not quoted.

This volume represents the main proceedings of the "Study Mission" of ten Asian Countries on Management of Irrigation Facilities organised by the APO in Tokyo during 18 - 28 June, 1991. Countries that participated are Japan, China, India, Indonesia, Malayasia, Thailand, Sri Lanka, Nepal, Fiji and Hongkong—notable absentees are Korea, Pakistan, Philippines, Bangaladesh, Myammar (Burma) and many others. Irrigation Management in Asia by Dr. C.M. Wijayaratna of International Irrigation Management Institute, Philippines formed the key note paper (1) of the 10-day 10-nations study mission but the paper was neither presente/discussed nor included in the highlights of the proceedings as the author could not be present due to disruption of air services because of eruption of Mt. Pinatobo near Manila. However, this paper is included in the book for the benefit of the readers.

The study-mission had presentation of papers in two distinctly different heads under (a) "Resources Papers" — a total of four papers — but only three (all on Japan) were actually presented and (b) "Country Papers" — a total of eleven papers from the remaining nine countries including one paper only from India. Emphasis was on field studies since the participants spent 6 out of 10 days in visiting various Agricultural Projects in Japan. Eleven participants, mostly govt officials of irrigation departments from nine member countries of APO and three "Resource Speakers" (all from Japan) definitely benefitted from one another's experience and visits to the projects. The quality of the country papers were mostly informative in nature as to the present status in each country, organisational aspects and future direction of irrigation development. The resource papers discussed aspects of irrigation drainage, farming and land improvement experiences of Japan. The field studies were done at the National Research Institute of Agricultural Engineering in Ibaraki Prefecture and several Irrigation and drainage projects, land consolidation projects, a land improvement district and a farm household in Miyagi Prefecture. These exposed the participants to modern trends in Japanese agriculture.

India has some of the largest multipurpose/irrigation dams in the world and an annual subsidy of Rs. 14000 crores for irrigation water for cultivation of wide varieties of crops including rice. The execution of the Sardar Sarovar Project is attracting the attention of the world. Drip irrigation is catching on in a big way. But India's leadership in the field goes practically unnoticed and the only Indian author/representative from Govt of Madhya Pradesh, Bhopal provided a rather sketchy outline of existing irrigation facilities, brief past history, present organisation for management and an equally unattractive summary of future directions.

There are, however, quite a few important aspects brought out in the various other papers. All the ten countries have their irrigation water planned mainly for rice cultivation. The experience of tiny Hongkong shows that the many water disputes there have risen from the fact that irrigation water is supplied free—farmers are reluctant to invest money on irrigation. Silting of reservoirs is also causing problems. Experimentation to introduce foreign types of crops alien to the soil need a new approach for planning as they require more water to grow faster. In Indonesia, as well as Thailand, two types of irrigation system management—government-managed system and community-managed system are in use. In contrast for crop diversification needs, China

is implementing a rotational system of irrigation water whereby the water is distributed to farmers in appropriate quantities at the right time and the proper order. The regular operation of irrigation association is financed mostly by membership fees based on water-use, part of the costs are, however, subsidized yearly by the Govt. China is also considering training for farmers and computer applications for irrigation management and to prevent water wastage.

The Japanese examples of advanced farm technology, higher agricultural productivity through land consolidation and pipeline irrigation, farm households etc are ideas worth pursuing in developing countries. Japan is also engaged since 1988 in developing new techniques through agricultural engineering research in their National Research Institute in the Science City of Tsukuba. Indian expertise in these fields in the CWPRs, Pune/ICAR, New Delhi/ICRISAT, Hyderabad may be comparable, the only difference being our outlook and poor efficiency. Japan has also emphasised on needs to reduce flood damages through proper drainage. The operation, maintenance and management (OMM) of land improvement facilities in Japan should also be reviewed for possible adoptation in India in the years to come. In the face of competing water requirements by other sectors, more economic uses of water will have to be devised e.g. drip irrigation becoming more popular now.

The papers dealt with only irrigation aspects. Irrigation water no doubt is very important but better yields need many other equally important inputs — quality seeds, fertilizers, farm chemicals, farming technology, land management, efficient labour, watershed development, financial assistance to farmers and so on. These, however, find little mention. However, in the foreword Nago Yoshida, Secretary General of APO, highlights this interdependence as the "underlying issues" of the study mission.

The proceedings of each paper have been summarised in Part I of the book and the main papers are published in Part II (Resources Papers) and Part III (country papers) of the book. There are no records of discussions held and lessons learnt, nor any broad guidelines for development of common irrigation facilities. To that extent, the overall benefits from the study mission appear to be rather limited. The "National Seminar on Water Management - the Key to Developing Agriculture" held in New Delhi in 1986 was much more broad based and covered greater details regarding overall agricultural productivity and management. Its findings and wealth of information are far ahead of the present volume published by the APO.

The get-up of the book is attractive. There are some spelling mistakes here and there e.g. Madhya Pradesh is spelt as "Mahya" Pradesh etc. and the pages should have headings of the topics for easy reference as in all technical publications. The book will be valuable to policy makers, practitioners and agricultural/management personnel. National Productivity Council of India will do well to initiate measures for adoptation of some of the advanced features in India to modernise our agricultural management for the 21st century.

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Policy Analysis and Problem-Solving for Social Systems by P.N. Rastogi, Sage Publications India Pvt. Ltd., New Delhi, 1992, 150p, Rs. 180.

In this book, the author has claimed to have used Cybernetic Methodology to enable the reader to understand complex and ill-defined (according to the author) social problems such as corruption, ethnic tensions (leading to inter-group violence), rural poverty, terrorism etc. He makes use of concepts such as negative feed-back cycles, positive feed-back cycles, multi-loop cycles to indicate inter-relationships between various contributors to such problems. He has even attempted to identify the crucial contributors. He argues that policy makers should concentrate their efforts to formulate policies to take care of these issues. And he believes that these complex problems can be solved.

I certainly appreciate the logic of such an approach but question its practicability. The author seems to believe that because of inadequate understanding about the contributors to such problems, the policy makers are unable to evolve policy guidelines and implement the necessary decisions. Here I disagree with the author. As an illustration, let us consider the problem of corruption. Everyone agrees that corruption has almost become a way of life. And many of us believe that it is extremely difficult to eradicate this evil. But the reason for this is not inadequate understanding of this problem and the possible solutions. Solutions to the problem are also known. What is lacking is the necessary political will as our political leaders depend upon corrupt people for support and dare not take any action against such persons. The author mentions the following as goal states to be achieved in order to root out corruption :

i) The number of corrupt transactions is virtually nil.

ii) Detection procedures/mechanisms are effective, efficient and timely.

iii) Corrupt persons are successfully prosecuted and punished without time delays.

iv) The orientation of the organisations personnel toward corrupt practices is absent.

There is nothing new in these ideas. In fact, (ii), (iii), and (iv) are the means to achieve (i). It is easier to say that corrupt persons should be successfully prosecuted and punished. But will it happen? 'Bofors' case is nowhere near solution even after 5-6 years. 'Antulay' case is still pending after about 8-10 years. Apparently 'evidence' is there but the cases are still pending. Our organizational theories tell us that it is impossible to design an organization structure wherein employees would not get opportunities of resorting to corruption. At any level, including the lowest, there are areas of discretion for the employees and therefore if they want to, they can resort to corrupt practices. Persuading persons not to be corrupt is easier said than done. Philosophers through the ages have been complaining about 'perverse' human nature and such persons seem to be multiplying. When an ordinary citizen hears or reads about corrupt people in high places, he only laments the fact that he does not get such opportunities.

I have dealt with the problem of corruption in detail only to illustrate the point. Similarly, mass poverty, inter-group tensons and other such problems are not being tackled for the simple reason that persons in positions of power have vested interest in ensuring that such problems are perpetuated so that they can cling to their positions.

The author's claim that these problems are poorly understood and therefore, they are not being successfully tackled is not acceptable. Even a gullible naive reader is aware of the solutions to such problems. I was quite shocked to read chapter 9, wherein the author seeks divine intervention to solve out social problems. This is not expected of a social scientist.

Brevity is virtue of this book. But reading and understanding the arguments is a tough job. Try your luck with a statement such as this — 'Multi-cycle structure achieves a state of stable equilibrium around the high viability values of its salient variables' (P 59). One is duly impressed with such language. By way of summary I would say that the methodology of the author is sound but this academic exercise only proves a point viz, in many social researches you only prove the obvious.

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Industrial Labour in India—An Empirical Approach by Pramod Verma, Oxford & IBH, New Delhi, 1992, 255p Rs, 160.

This is an original study of the quantitative effect of various factors on worker's wages, industrial employment, productivity, trade unionism, workplace relations and industrial conflict. The book presents an interesting insight into the relationships and interplay of different variables in the field of industrial relations.

It gives a perspective of trends in wages, employment, productivity, trade union membership and conflict indicators (like industrial disputes and loss of mandays) over the period 1960-80. The data is taken mostly from the "Annual Survey of Industries" and the publications of Labour Bureau, Simla. The data projects variations over time as well as over a cross section of different regions and industries. Some data relating to attitudinal and behavioural indicators of workplace relations and industrial relations at the regional level is based on sample surveys conducted by the author.

The author has drawn certain industrial relations hypotheses in the shape of statistical models. These hypotheses are suggested by the data profile. The author has then proceeded to test these models empirically. For instance, a hypothesis was drawn up that wage was influenced by economic factors like productivity, capital intensity, share of wages in the value added and the ratio of salaried staff to total employees in the shape of the following model:

$$W = \alpha + \beta_1 V + \beta_2 K + \beta_3 \frac{w}{V} + \beta_4 \frac{s}{E}$$

(where, W = wage,

V = Productivity (Net value added per worker)

K = Capital intensity

(total fixed capital per worker)

S = average salary,

E = Employment, α is a constant,

β_1, β_2, β_3 and β_4 are regression coefficients.)

Values and signs (+ or –) of the regression coefficients were known when data relating to wage, productivity, capital intensity etc. was fed into the equation. A high positive value of the coefficient would endorse the validity of the model. Productivity was found to be the most crucial variable influencing wage differentials. Share of wages in value added was also found to be significant. Apart from these, technical factors, job content and skill requirement were also found to have influenced wages.

The data revealed that the index of real wage was lower than the index of real productivity until 1977-78, when the real wage index outpaced productivity index. This trend should have been a serious national concern as increase in real wages would be justified only to the extent it was backed by productivity. But the real wage index continues to be higher than the productivity index. It is obvious that sustained rise in real wages in future will be dependent upon the efforts by the management and the labour in realising productivity levels. What could be the reasons for this trend? Is the growing power of unions protecting the wages of union members against the adverse effects of the dip in productivity? This trend coincides with the onset of a phase of more protectionist labour legislation. It was in March 1976 that Chapter V-B was added to the Industrial Disputes Act. This chapter contains provisions requiring employers of larger establishments to take previous permission of the appropriate government before lay off, retrenchment and closure. Did the curtailed freedom of employer to adjust his workforce impede productive utilisation of human and capital resources? The author, however, has not attempted to analyse the reasons.

The study reveals that the share of wages in value added in the Indian economy has remained steady between 30 to 38 per cent. Elsewhere the study concludes that growth in employment, across the industries, has been influenced positively by productivity changes and negatively by changes in wages and capital intensity. This explains the depressing effect of high wages, high capital intensity and low productivity on the growth of employment in the organised manufacturing sector. The study discovers a positive relationship between the growth in union membership and mandays lost. Unions are thus found to be subsisting on industrial conflict, which is not a healthy trend.

By venturing into the difficult task of quantifying the effect of variables in a field as complex as industrial relations, the author has done a pioneering work in labour economics. Some behavioural, attitudinal and technological effects, by their very nature, however, are not amenable to mathematical formulations. All the same the analysis leads to significant conclusions, many of them with policy implications.

In a mixed economy, labour policy seeks to draw a balance between the interest of economic growth and social justice for the working classes. As both the economic and social conditions continuously undergo change, this essentially has to be a dynamic balance which needs to be periodically adjusted. This publication is topical, and eminently readable because it comes at a time when labour policy is slated for adjustments keeping in view the recent changes in economic policy.

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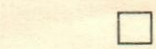

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