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APRIL — JUNE 1975

V. K. Goel
Editor

PRODUCTIVITY, the principal organ of the National Productivity Council of India, is a professional, research-based Journal, providing techno-managerial expertise for a productive expansion of the Indian economy. It disseminates knowledge of the latest productivity techniques for pushing forward the growth of Indian Industry, and features from time to time the best available papers dealing with different techniques and facets of productivity, and on all aspects of the national economy.

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Conspectus

IN THE FOCUS

Productivity Measurement

Productivity as a concept carries a multitude of measures; to some it measures the personal efficiency of the labour; to others, it is the output derived from a composite bundle of resources; and to the more philosophic, it is almost synonymous with welfare. With such differing notions of productivity, it is not surprising to note the wide variations in its measurement too. And, accordingly, one witnesses a great multiplicity of tools and techniques that has been developed for measuring productivity. These variations are also reflected in the various articles that have been included in the issue. Each one of them attempts to define the concept of productivity in its own way before it actually measures it. Nevertheless, a debate on the various approaches to measurement of productivity is necessary in order to arrive at some concensus on the methodology of measurement of productivity which is best suited to Indian conditions. It is precisely with this hope that the problem of measurement of productivity has been brought in the focus of this issue.

—Editor

Total Factor Productivity and the Price Indices

Total factor productivity attempts to examine the impact of technological progress by comparing total output with a weighted combination of various inputs. Measuring total factor productivity is nothing but measuring the rise in total production that is due to increase in marginal productivity of factors. This paper tends to suggest that the problem of measuring the total factor productivity is similar to the problem of measuring general price level for purposes of constructing either an index of national income or an index of output in physical terms . . . . Bishwanath Goldar (Page 513)

Allocative Efficiency in Indian Agriculture

This paper measures and analyses the allocative efficiency of factors like labour and capital in Indian agriculture with various sizes of farms. The estimated general expansion path bends towards labour indicating the scarcity of capital, and its substitution with surplus labour. The estimates of "rationality" indices of labour are higher and close to unity than that of capital, thus, confirming that farmers do employ surplus labour rationally and efficiently. The degree of "irrationality" in the case of capital and capital equipments can be explained in terms of price rigidities and monopoly elements in capital availability . . . . Gopal Kadekodi (Page 518)

Tractorisation and Farm Productivity

Advocates of tractorisation of Indian agriculture plead that it contributes towards increased farm outputs and also creates additional jobs in agriculture and non-agriculture sectors. But such an argument assumes that increase in farm productivity will be large enough to more than neutralise the labour saving effects of tractorisation. This paper examines the impact of tractorisation on farm productivity in the light of the above hypothesis and shows that tractorisation has made negligible impact and that developmental efforts should be concentrated on increasing irrigation facilities and the use of fertilisers. . . . R.K. Sharma (Page 534)

Agricultural Productivity, Adoption of New Technology and Small Farmers : An Inter-State Analysis

Analyses the extent of knowledge and adoption of new agricultural technology by small farmers, evaluates gains accruing from it and identifies the factors discouraging the small farmers from adopting the new technology. Of the four improved agricultural practices, use of improved seeds and chemical fertilisers is well known and practiced more as compared to practices such as green manuring and plant protection. Small farmers do respond favourably to the use of new agricultural practices because they have contributed substantially to their incomes. But for majority of the farmers in most of the states, lack of knowledge, uncovincing economic returns, availability of inputs in time on reasonable prices, availability of finances, etc., come in their way. . . . S.M. Pandey (Page 542).

Economies of Scale and Productivity Change in the Indian Manufacturing Industry

One of the important but neglected tasks is to develop economic relations between factors of production and output in manufacturing industries. This enables to have better insights into the determinants of production and productivity in the right perspective. This paper is one such attempt to estimate output elasticities and productivity change in Indian agro-based manufacturing industries with the help of Cobb-Douglas' Production Function. It shows that the scale elasticities in agro-processing industries and in most of the industries in the manufacturing sector as a whole is high and the elasticity of output to labour is significant. . . . M.A. Oommen (Page 544).

Productivity Trends in Large Scale Manufacturing Industry : A Comparative Study

A comparative study of the productivity trends between the large scale manufacturing sector of Bihar and manufacturing sector as a whole shows that Total Factor Productivity is considerably influenced by the trend in Capital Productivity at both the levels. A decline in capital productivity has led to a decline in total factor productivity index. Also the capital productivity in Bihar is low when compared to All India, which implies that fuller utilisation of the existing capital in the state is called for before any further investment. Meanwhile, for new industrial projects, labour intensive methods of production may be more appropriate. . . . I. N. Mukherjee (Page 560)

Productivity in Cotton Textile Industry in India

The paper presents a broad picture of productivity trends in Cotton Textile Industry. It shows that phycal output in quality and value terms has increased during 1949 and 1966. On an average, for one rupee of investment, the value added by manufacturer is Rs. 0.63 per year which is better than in most of the industries. But labour productivity has remained almost constant, even though real wages and salaries have gone up. In spite of all the success achieved, an extensive use and better utilisation of modern technology and techniques is called for the future growth of the industry. . . . M.C. Jaiswal, B. B. Jani (Page 575)

Productivity in Rolling Mills

Rolling Mills are an important part of the steel industry in India. However, their performance is far from satisfactory. This paper attempts to explain the reasons for low productivity of rolling mills. Some of the major causes identified are lack of under-utilisation of capacity, careless handling of rolls, wastage of time in changing rolls, etc. This calls for not only improved technical know-how but also a concerted effort to reorganise the industries on modern management lines. . . .R. Singh, B. Lakshminarayan (Page 593)

Productivity & Unit Costs of Indian Educational System

Though it is not easy to measure the productivity of education, this paper shows that productivity of Indian educational system as measured by the ratio pass-outs to total students enrolled and the teacher-students ratios records an improvement, whereas, the educational productivity defined as the reciprocal of the unit costs, shows a decrease for most of the institutions for the same period. Also, while the flow coefficients of education seem to have been taken care of by quantitative expansion, there seems to be a tendency to dilute the standard of stocks with the educational institutions. . . .Shri Prakash (Page 600)

On Value Assurance as the Total System

Maximising profits or output, or minimising costs or inputs with improvement in quality is one of objectives of management. But, this by itself may not encompass all the aspects of the system's operation. While the emphasis on quality control is a welcome feature, it should also take into account the cost-benefit ratio to make the quality improvement most economical and to the advantage of consumer. Ideally, such a cost benefit analysis should be built into any managerial system. This paper highlights the importance of management by *Value Assurance* and reviews some of the concepts of value engineering. . . .Prem Vrat (Page 612)

Objective Anatomy of Overheads

An effective control of different types of overheads in a firm/industry, considerably influences the production costs. Conventional techniques like budgetary control and cost accounting are not adequately equipped to control overheads effectively. This paper suggests that application of ABC analysis to control overheads would provide the management with more effective means of having a close watch on important items of overheads. . . .P. Chattopadhyay (Page 619)

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In The Focus *TRANSFER OF TECHNOLOGY*

Some of the Aspects Covered Are :

1. International Transfer of Technology—Myth and Realities.
2. Technology Transfer and the Role of the Multinational Corporations.
3. Technology Transfer and the Role of Specialized International Agencies.
4. Transfer of Technology Between Developing Nations.
5. Social Cost-Benefit Analysis of Foreign Collaborations.
6. Economic Worthiness of Foreign Collaborations.
7. Technology Transfer and the Role of Specialised Institutions in India.
8. Appropriate Technology Suitable for Indian Industries.
9. Technological Development and Science Policy—An Appraisal of the Past Programmes in India.
10. Technological Dependance of Developing Nations.
11. Technological Development in Industries—Trends and Problems.

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Conspectus

IN THE FOCUS

Transfer of Technology

The urge for rapid industrialisation, in the absence of a viable structural base sufficient to initiate and sustain the desired tempo of development, has given a new impetus to the import of foreign capital and technology by developing countries. But in the light of the U. N. Report on Multi-National Corporations, the developing nations have given a second thought to the question whether foreign capital and technology are really the propellants to their economic development. This sense of awareness has made them realise that apart from various methods of collabrations with the developed nations, a strong R & D base is a pre-requisite to assimilate the suitable imported technology and develop indigenous technology to suit their own conditions. The purpose of bringing this problem in the focus of this issue is to highlight the various problems that are connected with the transfer of technology both indigenous and imported. It is hoped that contributions from noted experts both from India and abroad might help in evolving a suitable policy framework on such an important aspect of economic development.

—Editor

International Transfer of Technology : Myths and Facts

In the process of transfer of technology, the buyer and seller should ideally trade on equal terms. But the inadequate knowledge on the part of the developing countries weakens their bargaining capacity. On the pretext of investing in developmental research, multi-nationals hold nearly 95 per cent of patents in developing countries. Taking a cue from the drugs industry, this paper shows that it is not necessarily for technology that a developing country is paying, instead, it is for the perpetuation of monopoly rights of multi-national corporations which is being paid for by them.

.....Sumitra Chishti (Page 663)

Transfer of Technology Among Developing Nations

Transfer of technology among the developing nations is much more advantageous than from developed to developing countries. The technology developed within the developing countries takes due care of their local peculiarities both climatic and socio-economic. This may not be the case with the highly sophisticated technology developed in the developed world. It is not to say that there should be no transfer of technology from developed to developing country. This may be necessary at least in the near future. What is, however, to be recognised is the fact that within the developing nations there are countries which can supply technology to other developing countries which may be more in line with their socio-economic needs. This would, however, call for greater mutual cooperation among the developing countries to enable such transfers..... T. N. Chaturvedi (Page 668)

Transfer of Technology from Developed to Developing Countries

An ill-digested exotic technology may result in wastage of scarce capital and raw materials resources in a developing country. In order to prevent such an eventuality, this paper suggests that the actual needs of the recipient countries should be assessed to enable them to opt for the right type of technology to suit their own factor situation. In India, due to financial stringency, capital intensive technology (maximising re-investment quotient) should be restricted to basic industries, whereas labour intensive technology (maximising social marginal productivity) should be applied to the remaining industries..... Subas C. Pati Prahallad Panda (Page 689)

Appropriate Technology for India

The impulse for developing a technological base should come from within and as such the process of modernisation must start from the bottom as against the conventional approach to promote technological change from the top. This task can be accomplished only by the adoption of 'appropriate technologies' at the lower levels coupled with the adoption of sophisticated science-based technologies at the top. This paper suggests that the talent in our research institutions and of local artisans and craftsmen should be mobilised and utilised to develop several appropriate technologies, in order to transform India.
M. S. Iyengar (Page 759)

Fiscal Policy & Appropriate Technology

The fiscal policy adopted in India has not only tolerated inappropriate technologies, but has even deliberately favoured their adoption, resulting in the decline in labour intensity of output. Policy measures which can change this situation and favour a pro-labour factor-mix include : complete withdrawal of all fiscal incentives relating to the use of capital; complete disallowance of interest as expenditure for tax purposes; substantial reduction in the incidence of corporate tax on consumer goods industries; and reduction in the incidence of excise duty and other taxes on these goods.....Anand P. Gupta (Page 767)

Transfer of Sponge Iron Production Technology from Laboratory to Industry

The development of an indigenous technical knowhow to produce sponge iron commercially is a significant pointer towards the capability of Indian technologists and scientists to develop, for commercial exploitation, even sophisticated technology which is presently being imported from the developed world. Taking a cue from this case study, the authors plead with Indian entrepreneurs not only to encourage the indigenous talent but also to put faith in indigenous technology and be prepared to take calculated risk in using the indigenously developed technology.....V. A. Altekar V. S. Sampath (Page 779)

Building with Plastics : Prospects for Regional Collaboration

In a country like India where housing and housing materials are in extreme short supply, plastics building materials provide an effective alternative. Though the concept of low cost housing by building with plastics may not be achieved directly, there are evidences, according to the author, of successful experience in upgrading the utilities and services in the building industry through the use of plastics building materials. Plastics materials may advantageously be used for piping systems, sanitary hardwares and fixtures, flushing cisterns, door and window frames, sliding panels, etc. Fortunately, the country has required competence to produce plastics building materials and thus, gradual replacement of plastics building materials with the traditional building materials might help in removing the bottlenecks in the supply of essential building materials. O. P. Ratra (Page 785)

Development Strategy for Electronics Industry : Ensuring Success of Technology Innovation

Technological innovation is a total process consisting of an 'innovation change' made up of a number of mutually inter-dependent links. The three essential elements of such a process are—conceptualisation, institutionalisation and implementation of technological innovation. Confining to the electronics industry, the author attempts to develop a strategy for bringing out technological innovation and defines the essential elements of this new strategy... A Parthasarathi (Page 798)

Exotic Technology And Performance of the Indian Economy : Key Areas of Failure

Since independence there has been a heavy import of foreign technology in India irrespective of whether the socio-economic conditions are receptive to such an import or not. Quite often, as has been the case in some of the public sector undertakings, it results into under-utilisation of capacity and their poor economic performance. Further, our fancy to highly sophisticated technology has also inhibited the growth of indigenous technology. It is imperative, therefore, that the import of exotic technology should be very selective, gradually giving way to the development of indigenous technology. At the same time, efforts should be made to make full utilisation of the imported technology..... V. S. Mahajan (Page 812)

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In The Focus *CAPACITY UTILISATION*

Some of the Aspects Covered are :

1. Industrial Capacity : Concepts and Measurement
2. Measurement of Capacity Utilisation in Indian Industries
3. The Effects of Underutilisation of Capacity on Costs and Profitabilities
4. Problems of Capacity Utilisation in Indian Engineering Industries and Process Industries
5. Prospects of Capacity Utilisation in the Seventies
6. Technological Factors and Capacity Utilisation
7. Input Shortages and Capacity Utilisation
8. Human Factors in Underutilisation of Capacity
9. The Impact of Import Restrictions on Capacity Utilisation
10. Computer Services in Aid of Capacity Utilisation in Engineering and Process Industries
11. Capacity Utilisation Problems in Public and Private Sectors
12. Measures for Better Utilisation of Industrial Capacity
13. Underutilisation of Capacity and Planning Strategies : Export Promotion or Import Substitution ?
14. Capacity Planning and Utilisation--Role of the Management

Conspectus

IN THE FOCUS

Capacity Utilisation

In a capital starved country, the importance of fullest possible utilization of industrial capacity, both in public and private sectors, can hardly be over-emphasized. This is necessary not only to ensure the optimum utilization of scarce capital resources that have already been invested in the industry, but also to create new capital for further development. A recent study on capacity utilization in Indian industry, however, paints a picture which is far from satisfactory. According to it, the average utilization of capacity in Indian industry ranges between 60 to 75 per cent of the total installed capacity. In the public sector, the Study maintains, the average utilization of capacity was 53 per cent in 1974-75. This low level of utilization of industrial capacity is a sharp pointer to the various inefficiencies and inadequacies of our system. While it may be admitted that some bias towards underutilization of capacity may be due to some methodological errors in determining capacity, but the fact remains that there is a substantial gap between installed capacity and its utilization. The causes for underutilization of capacity can be grouped under three broad categories, namely lack of infra-structure facilities, shortage of power and other essential inputs and last but not least, management-labour inefficiencies. How these impediments to fuller utilization of industrial capacity can be removed is a moot question which should be given highest priority in national thinking at all levels. Bringing this question in the focus of PRODUCTIVITY is a modest but timely step in this direction.

—Editor

Industrial Capacity : Concepts and Measurement

While assessing the industrial capacity, one should be clear about the concepts used and the methods of measuring capacity. Undoubtedly, a plant is not available for 'On Stream' productive purposes 100 per cent of the time. Therefore, at the time of sizing the plant, factors like maintenance, inspection, cleaning and overhauling should be considered and on the basis of this, 'Stream Factor' should be computed. In the case of multiple products, the concept of equivalence should be used. This paper, while dealing with the above two concepts, clarifies the misconceptions regarding the comparison of capacity utilization and whether capacity utilization can be more than 100 per cent. . V. T. Kale (Page 841)

On Utilising Capacity

Expansion of capacity is a welcome feature, provided it is followed after the fullest utilization of existing capacity. This paper scans through the literature on capacity utilization and establishes that in industries like engineering, iron and steel, cement, etc., there is much scope to utilize the existing capacity, which has so far remained unutilised. So much so, the extra built-in capacities in process plants can be re-rated which can increase their capacity by more than 50 per cent. Therefore, in the face of resource limitations, facing India and the export opportunities, it behooves on every entrepreneur to explore the possibilities of stretching the capability of his plant to the fullest extent..... K. Venugopal (Page 848)

Capacity Determination Through Linear Programming

In engineering units where discrete product lines exist where all work centres are balanced and arranged in a line to facilitate streamlined flow of materials to form the finished products, the capacity in terms of physical output can be arrived at by identifying the critical (bottleneck) work centres. But for units, producing a variety of products, involving manual operations, capacity determination is a difficult task. In such units the application of linear programming might help in determining capacity in a scientific manner. This approach not only takes into account all the critical work centres, but also supplies overall picture both to planners and the management to monitor the capacity utilization.....S. A. Khader... (Page 893)

Underutilisation of Capacity in Indian Industries : 1969–73

It is well known that through better utilisation of existing capacities, it is possible to bring down the existing capital-output and labour-output ratios which, in turn, would mean more income and a possible increase in employment. While some excess capacity is bound to exist because of exogenous factors that are beyond the control of an organisation, it could however, be minimised by keeping under control the endogenous factors that hamper capacity utilisation. This can be done by making systematic and regular analysis of the causes of underutilisation of capacity..... Hardip Singh (Page 903)

Maintenance for Capacity Utilization

The importance of an effective maintenance system in the fuller utilization of industrial capacity, particularly in process industries can hardly be overstated. It is only through maintenance that any industry could ensure the maximum utilization of the 'on stream time', in turn permitting also the fuller utilization of capacity. The advance in science and technology has, among other things, also facilitated the development of newer maintenance tools and techniques in the areas like material inspection, cleaning, testing, value engineering tribology and so on. It will be myopic to consider these new tools and techniques as costly ventures because the cost of maintenance may be high. But, the higher will be the cost of breakdowns. It is imperative for every industrial unit, therefore, to have a well established and effective maintenance system using the latest tools and techniques in the field..... M. S. Mitra (Page 913)

Managing Capacity in Indian Industries

Utilisation of capacity can be regarded as one of the most important indicators of efficient running of an enterprise. The accelerated growth of an enterprise depends on sustained creation of new capacities and an optimum use of existing capacity of plant and machinery. No doubt, factors like scarcity of power, raw materials, lack of demand, etc., do come in the way of capacity utilisation but bad management practices are also responsible, to a great extent, for lower utilisation. Capacity utilisation can, thus be improved by taking suitable techno-managerial measures. It should further be recognised that ultimately it is the human element which plays a decisive role in improving the performance of any organisation.....N. C. Joshi (Page 918)

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1. Corporate Planning as a Tool of Effective Management
2. Corporate Planning in the Context of National Plans
3. Problems of Implementing Corporate Plans
4. Corporate Planning and National Policies
5. Management by Objectives
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7. Business Diversification, Integration and Specialisation
8. Conversion of Business Strategic Plans into Tactical Plans
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10. Techniques of Formulating Corporate Plans
11. Planning Business Growth and Diversification
12. Role of Research and Development in Business Growth
13. Techniques of Determining Business Targets
14. Application of Corporate Planning in Smaller Corporations

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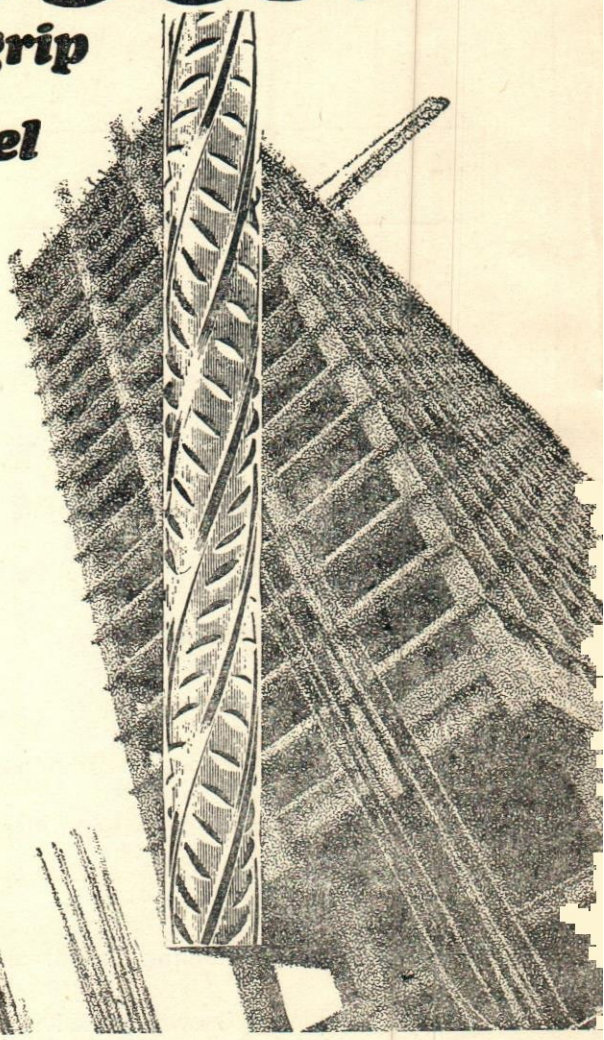

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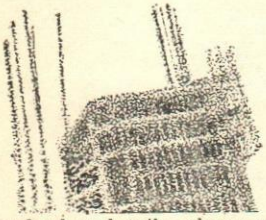

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IN THE FOCUS

Corporate Planning

Most companies seem to find it difficult to have realistic objectives for their enterprises. It is clear that in the absence of such objectives, the investments made from time to time, whether in machinery or other inputs, obviously cannot yield adequate returns. This leads to neutralisation of available energy, waste of raw materials and stagnation of the enterprise. The question is how to avoid all this. Obviously the planner has not only to keep the national objectives in mind but also to realise those of them that fall within his sphere consistently with the objectives of his own enterprise. But the latter, too, have to be realistic. The next question, therefore, is how best to determine realistic objectives for the enterprise. This again is none too easy, for he all too often finds himself pulled in different directions by his various departments. Corporate Planning techniques are designed precisely to overcome these problems by integrating the individual operational objectives and orienting them to the larger objectives. The purpose of bringing up this problem into focus in this issue of 'PRODUCTIVITY' is not only to highlight its importance but also to apprise the industry of some of the latest developments in the field of corporate planning and of its benefits..... *—Editor*

Corporate Planning in the Context of National Planning

The national plan indicates the broad areas of development a country is expected to follow and provides valuable information to the corporate planner. In order, however, to interpret a plan meaningfully, the targets set in the plan need to be treated with some circumspection. First, the targets for industry groupings must be separated into product-wise demand. Secondly, the implications of the physical targets must be translated into economic and financial terms to determine the profitability of entering a particular field. Finally, the targets set for various industries are highly inter-dependent and any shortfall in the output of crucial sectors can upset the targets of other industries. Thus, it is important for a corporate planner to understand the strategy and assumptions underlying the plan. This will enable him to reassess the segment of the plan in which he is interested, if some of the assumptions go wrong .....
C. Rangarajan (Page 985)

Corporate Planning and National Policies

The inter-relationship between corporate planning and national policies is significant in planned mixed economies because many of the objectives of the national strategy are sought to be realised through the performance of the corporate sector. This calls for stability and consistency of national plans and policies which in turn determine the nature of the environment in which strategic choices are accomplished. Besides developing suitable policies, their interpretation and co-ordination of the objectives of the national plan and corporate plans ensure stable relationships within the system. But proper implementation of corporate plans ensure the realisation of national objectives ..... C.N.S.Nambudiri (Page 1002)

Measuring the Need for Corporate Planning

This paper provides a preliminary framework for assessing the degree of the need for corporate planning within an enterprise based on data of certain objective factors such as : desired demand, depth of processing, competition, foreign ownership, capital intensity etc. With an inventory of the structural environmental factors, a firm can use the framework to assess the degree of planning it needs. Expressing each factor on a five-point scale, this paper shows that if firms in the same industry adopt a common matrix, then the higher the score obtained by a firm the greater should be its need to engage in corporate planning .. S.K. Chakraborty (Page 1016)

The Corporate Planning Process : A New Approach

Corporate planning is a technique to achieve a desired structure of business. Since corporate objectives are abstract and difficult to relate to action required to achieve them, the main objectives are segregated into sub-objectives till action relevant sub-objectives are reached. Thus, if the latter are achieved, it implies that corporate objectives are achieved. This paper shows that to achieve the sub-objectives, action plans have to be proposed, keeping in view the resource plans. In other words, the three essential constituents of corporate planning are target structure, action plans and resource plans.....Rakesh Kumar (Page 1033)

Corporate Planning in a Multi-Product Organisation

In a multi-product organisation, long-range planning is carried out at the corporate and individual business levels. The process of defining objectives and developing strategies follows the 'top-downwards' course where quantified objectives are first set for the company and then different roles are assigned to individual businesses to suit the corporate interests. While developing a strategy, aspects such as soundness of investment and financing policy and adequacy of cash flow should be considered. And on the basis of this, the preferred strategy is concretised in a financial statement showing sales, growth percentage in sales, profitability percentage etc., which are helpful in charting action programmes to achieve the objectives of the business during the plan period... P.C. Basu (Page 1043)

Management by Objectives

This paper presents a complete 'expose' of the doctrine of 'Management by Objectives' and seeks to understand its obvious fallacies so as to prevent any wasted effort on the part of the executives. The basic assumptions, that the objectives be dynamic, that every employee should work for those objectives, that the objectives be communicable, that departmental sub-objectives be sacrificed for higher organisational objectives, etc., appear to be superficial and, at the action level, even detrimental. 'Management by Action' is an alternative approach which confronts a situation directly and actively solves problems. And in doing so, it awakens the organisation, shakes off lethargy and establishes a sense of individuality, identity and purposefulness..... N.K. Sethi, (Page 1051)

Some Aspects of Company Planning

Basically, planning at the corporate level calls for a detailed and careful consideration of the company's resources, its strengths and weaknesses, with a view to formulating explicit objectives and deciding the lines along which the company should be guided. A further break up of objectives into its constituent elements is necessary to examine and test the precise means by which the company will reach the desired goals. If, in the process, it turns out that some steps required to be taken are beyond the company's resources, then the plan has to be suitably modified. In other words, what is required in planning is quick response to change.....Ashoke Banerjee (Page 1062)

Role of Research and Development in Business Growth

Though Research and Development is commonly understood in the context of technology, it has a much wider connotation. It is innovative marketing which actualises the potential of a technology. Besides, innovations may occur in the product, material manufacturing methods, distribution methods, inventories etc. In fact, innovations are frequently sparked off by the interactions of disciplines or activities. This paper examines the role of innovation in business growth in India.....T.K. Mukherjee (Page 1073)

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Total Factor Productivity and the Price Indices

Bishwanath Goldar*

The problem of measuring total factor productivity which tries to examine the impact of technological progress by comparing total output with a weighted combination of various inputs, is very similar to the problem of measuring the general price level. In connection with the definition of the problem of index number Mudgett [1] states :

"Since all influences operating on the value ratio are comprehended within these two terms, price and quality change, we define the index number problem as the problem of breaking up a value ratio into its basic components factors P_{01} and Q_{01}."[1]

In the above definition P_{01} denotes the price index and Q_{01} the quantity index. The problem of measuring total factor productivity can be put in an exact form in case of constant returns to scale, which many of the total factor productivity measures assume[2]. Between two situations production has changed. In both the situations, the production is equal to the various factors multiplied by their respective marginal productivities[3]. Thus, the change of production between these two situations is due to change in marginal productivities and/or change in factors. The problem of measuring total factor productivity is nothing but measuring the rise in total production that is due to increase in marginal productivity of factors. Such an index will be called marginal productivity index on total factor productivity index. And the part of increase in production that is due to increase in the quantity of factors used will be called the factor endowment index.

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1. Some writers prefer to call it multi-factor productivity as it is not possible to cover all factors of production. See, for example, Brown [2]. Though in the present paper we are confining ourselves to labour and capital only, the analysis presented can be extended to more than two factors.
2. See Brown [2], Domar [5, 6] and Solow [7].
3. This is because of constant return to scale and Eular's theorem.

Consider, now Kendrick's measure of total factor productivity [3, 4]. The index of total factor productivity is written as

$$\frac{P_1 / P_0}{WL_1 + rK_1 / WL_0 + rK_0} \qquad \ldots(1)$$

where P denotes production, L and K denotes labour and capital and W and r refer to wage rate and rate of interest, which are assumed to be equal to the marginal productivity of labour and capital. We have a choice with respect to the period whose wage and interest is used for calculating the total factor productivity index. If base year wage and interest is used[4], equation 1 becomes

$$\frac{W_1 L_1 + r_1 K_1}{W_0 L_1 + r_0 K_1} \qquad \ldots(2)$$

Clearly, this is the Paasche index of marginal productivities using current period labour and capital as weights. If, instead, we take the current year wage and interest rate, then equation 1 can be written as[5]

$$\frac{W_1 L_0 + r_1 K_0}{W_0 L_0 + r_0 K_0} \qquad \ldots(3)$$

Clearly, this is the Laspayer's index of marginal productivities using base period factors as weights.

The next two indices, the Geometric index and the CES index[6], base themselves on the following equation[7]:

$$\left.\begin{aligned} P_{0_1} &= A_{0_1} \cdot E_{0_1} \\ A_{0_1} &= P_{0_1} \div E_{0_1} \end{aligned}\right\} \qquad \ldots(4)$$

where P_{0_1} denotes production ratio, A_{0_1}, the total factor productivity index and E_{0_1}, the factor endowment index. The Geometric index and

4. See Kleiman et. al. [4]
5. See Kleiman et. al [4]
6. See Domar [5, 6], Brown [2]
7. This equation is again the basis of factor reversal test [1].

the CES index is written respectively as

$$A = P / L_1^{a} K_1^{1-a} \quad \ldots (5)$$

and

$$A = P / \left[x\, L^{-p} + (1-x)\, K^{-p}\right]^{-1/p} \quad \ldots (6)$$

where ^{a} denotes the income share of labour in total production. Dividing and multiplying by base period production, P_0, we get

$$\frac{A_1}{A_0} = \frac{P_1}{P_0} \div \frac{L_1^{a} K_1^{1-a}}{L_0^{a} K_0^{1-a}} \quad \ldots (7)$$

and

$$A = \frac{P_1}{P_0} \div \frac{\left(xL_1^{-p} + (1-x)\, K_1^{-p}\right)^{-1/p}}{\left(xL_0^{-p} + (1-x)\, K_0^{-p}\right)^{-1/p}} \quad \ldots (8)$$

corresponding respectively to equations 5 and 6. The second term in the right hand side of equations 7 and 8, it is clearly realized, is the factor endowment index. In equation 7, it takes the form of weighted geometric mean and in equation 8, it takes the form of exponentially weighted harmonic mean.

Examine now the Solow's method [7]. The basic equation used by Solow for measuring the impact of technological progress is

$$\frac{\triangle A}{A} = \frac{\triangle P}{P} - \left(a \frac{\triangle L}{L} + (1-a) \frac{\triangle K}{K}\right) \quad \ldots (9)$$

It can equivalently be written as

$$\frac{A_1}{A_0} - 1 = \frac{P_1}{P_0} - \left(a \frac{L_1}{L_0} + (1-a) \frac{K_1}{K_0}\right) \quad \ldots (10)$$

If we use the base period a, the income share of labour in total production, equation 10 reduces to :

$$\frac{A_1}{A_0} - 1 = \frac{P_1}{P_0} - \left(\frac{W_0 L_1 + r_0 K_1}{W_0 L_0 + r_0 K_0}\right)$$

$$= \left(\frac{P_1}{P_0} - 1\right) - \left(\frac{W_0 L_1 + r_0 k_1}{W_0 L_0 + r_0 k_0} - 1\right) \qquad \ldots(11)$$

Thus, the rate of growth of total factor productivity is equal to the rate of growth of production minus the rate of growth in factor endowment. In index form, the rate of growth of total factor productivity equals production index minus the Laspayer's index of factor endowment. It should, however, be noted that equation 11 is not necessarily equal to equation 3, as Laspayer's index does not satisfy the factor reversal test. If, instead, the current period x is used, then equation 10 can be written as

$$\frac{A_1}{A_0} - 1 = \left(\frac{P_1}{P_0} - 1\right) - \left(\frac{W_1(L_1/L_0)\, L_1 + r_1\,(K_1/K_0)\, K_1}{W_1(L_1/L_0)\, L_0 + r_1\,(K_1/K_0)\, K_0} - 1\right) \quad \ldots (12)$$

Clearly, the second term in the right handside of equation 12 is similar to Paasche factor endowment index using current period weights $W_1\,(L_1/L_0)$ and $r_1\,(K_1/K_0)$.

Thus, the Geometric index, the C.E.S. index and the Solow method use a round about way of finding the movements in total factor productivity. It is like finding the price index by calculating national income at current prices and an index of output produced.

Using the indices developed in connection with the index number theory, better measures of total factor productivity can be formulated. Some of the important ones are given below :

1. $$\frac{1}{2}\left[\frac{W_1 L_0 + r_1 K_0}{W_0 L_0 + r_0 K_0} + \frac{W_1 L_1 + r_1 K_1}{W_0 L_1 + r_0 K_1}\right]$$

2. $$\sqrt{\frac{W_1 L_0 + r_1 K_0}{W_0 L_0 + r_0 K_0} \cdot \frac{W_1 L_1 + {}_1 K_1}{W_0 L_1 + r_0 K_1}}$$

3. $$\frac{(L_0 + L_1)\, W_1 + (K_1 + K_0)\, r_1}{(L_0 + L_1)\, W_0 + (K_1 + K_0)\, r_0}$$

4. $$\frac{\sqrt{L_1 L_0}\, W_1 + \sqrt{K_1 K_0}\, r_1}{\sqrt{L_1 L_0}\, W_0 + \sqrt{K_1 K_0}\, r_0}$$

5. $$\frac{L_a W_1 + K_a r_1}{L_a W_0 + K_a r_0}$$

In formula (5), L_a and K_a denote arbitrarily chosen values/weights of labour and capital. Note also that formula (3) is the Fisher's ideal index and formula (4) is the Marshall Edgewarth index.

REFERENCES

1. Mudgett, B.D.—"Index Numbers," 1951, John Wiley & Sons, Inc. New York.

2. Brown, M.—"On the Theory and Measurement of Technological Change", 1966, Cambridge University Press.

3. Kendrick, J.W.—"Productivity Trends in United States", 1961, NBER.

4. Kleiman, E., Levhari, D. and Halevi, N.—"The Relationship Between Two Measures of Total Productivity", *Review of Economics and Statistics,* Aug. 1966.

5. Domar, E.D.—"On Measurement of Technological Change" *Economic Journal* 1961.

6. Domar, E.D.—"On Total Productivity and All That" *Journal of Political Economy,* 1962.

7. Solow, R.M.—"Technological Change and Aggregate Production Function", *Review of Economics and Statistics,* 1957.

Allocative Efficiency in Indian Agriculture

Gopal Kadekodi

Measurement of allocative efficiency and analysis of factors responsible for misallocation of resources have gone in and out of economic literature for quite some time. Still, as long as the issue remains with the methodology itself [7], it is worthwhile to examine various alternatives to provide some guidelines on production technology and price policies. This paper is an attempt on the periphery of the whole issue of efficiency in agriculture, providing some clues on factor efficiencies and over-all allocative efficiency.

No doubt, land is the crucial input in the analysis of farm efficiencies. But, as in most traditional agricultural economies, in India, land is held more as a family asset rather than as a business unit. Hence, it is difficult to impute the cost on land. So, we considered other operating inputs on farms namely, labour and capital inputs. For sake of comparison of efficiencies between different sizes of farm holdings, all inputs and outputs are considered per unit of land holdings.

Using farm level data from the *Farm Management Studies*, an attempt is made to measure total rationality (i.e. allocation under profit maximisation criterion) and individual input use efficiencies. The variations in farm sizes and types of crops are also taken into account by grouping the farms into size groups and treating paddy farms and all crops (mainly wheat) farms of two sample districts separately (one from Northern India and the other from South).

It is hypothesized that Indian farmers are more rational in adjusting labour inputs than capital inputs at any given set of factor prices. The allocative efficiency increases with the size of farms up to a certain level and declines for large 'commercial' farms.

The efficiency of labour inputs can be attributed to the divisibility of family labour. Since land holdings in India are characterized as family

units rather than business units, divisibility of family labour helps them to allocate between agrarian activities and other productive activities.

The scope of this paper is restricted to the measurement of input factor efficiencies with different sizes of farms. An explanation for the variation of efficiencies between different sizes is very much in demand, but the data is insufficient for such an analysis.

On Measures of Allocative Efficiency

Ideally speaking, any measure of efficiency should be free from the functional bias due to the specification of a production function and also be independent of market conditions (i.e. specifications). But the matter is not simple to keep them separate. The production condition such that, given the input prices, the farmer utilises inputs in such combinations as to yield highest unit profit rate, is an indication of 'rationality'. Although, whether profit maximization is a rational behaviour or not is a different question in methodology, quite often, the farmer is unable to use such a 'best practice technique' of input utilization due to the fact that certain farm inputs are not readily available at the right time. In such situations, he either substitutes with other inputs or end up in paying higher prices for such scarce inputs. Such a divergence from 'rational' allocation of inputs in production is a mix of 'technical inefficiency' and 'price inefficiency'. As long as farmers substitute inputs, one for the other, within the range of technological feasibility, they are maintaining technical efficiency, though at a cost of paying a different set of prices to those inputs. Any use of inputs outside the feasible range can be taken as technically inefficient.

On the other hand, while attempting to use inputs in the feasible range of substitutability but not at the efficient levels, farmers may have to pay a different set of prices to the inputs. Such a deviation in prices increases the cost of farm production. This is a situation of price inefficiency. Use of bullocks to draw water in place of tubewells is a technically feasible substitution. But use of high-yielding variety of seeds in place of traditional variety of seeds without irrigation and fertilizer could be an illustration of technical inefficiency. Use of tractors in place of ploughs may give rise to high costs on farms of certain sizes. This high cost is due to the relatively high price of tractor use per unit

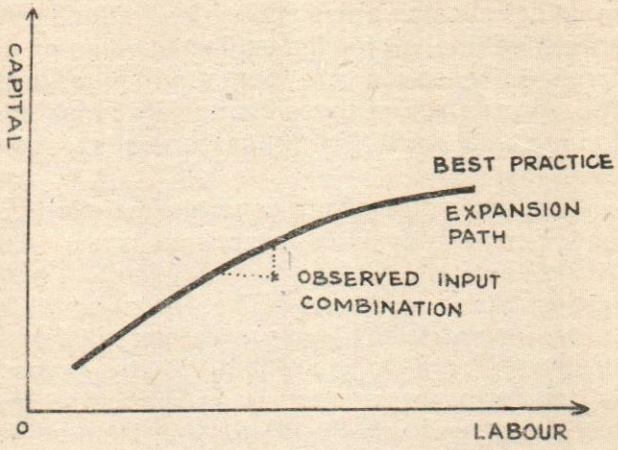
area as compared to the cost of using ploughs. At times such cases of price inefficiency may arise when the farmer has no choice but to pay such a price. Institutional factors and market imperfections lead to certain price rigidities [10].

In practice, the measurement of price and technical inefficiencies are difficult [3]. When farmers use a combination of inputs at a level different from the 'rational' level, the identification of technical inefficiency requires knowledge about the technological feasibility of input combinations, i.e. the nature of production function itself; price inefficiency is measurable only if sufficient information about the market input prices are available. In either case, *a priori* specifications of production function and market conditions are inherent. If a Cobb-Douglas (C-D) production technology is assumed, certain functional bias on the substitutability is introduced. To test for the validity of C-D and/or other production technology itself has various statistical problems [7]. Statistical regression procedure gives an (average) expected production surface instead of efficient production surface.

Among several attempts to test for efficiency in farm sectors, many have examined the total rationality rather than the price and technical rationalities [10,1]. Most of them have assumed a C-D technology in farm production. The non-identifiability of price and technical inefficiencies in the estimation sense, itself need not discourage attempts to measure allocative efficiencies in some form or other.

Present Approach

Since both C-D form and the more general Constant Elasticity of Substitution (CES) form of production specifications fall in the class of power functions, we assume a general power function for the production specification. We also assume for generality, imperfect factor and product markets. Details of specifications and other deductions are given in appendix. Under profit maximizing conditions, the farm expansion path is derived. Such an expansion path represents the best farm production behaviour. Testing 'rationality' of farmers using different combinations of inputs at different yield levels amounts to measure the 'distance' of input combinations away from the best practice expansion path.



A common technique of evaluating such distances (deviations) is to apply an Analysis of Variance Technique. We propose an alternative procedure.

Let L stand for the labour and K for capital inputs per acre on a farm yielding X units of output per acre. As derived in the appendix, the best practice expansion path can be written as :

$$\log K = a + b \log L \qquad \ldots(1)$$

where a and b are constants. However, the farmers deviate in their use of inputs of labour and capital away from such a rational expansion path due to input price rigidities, misallocation of resources, non-availability of certain input at certain time, etc. The functional form for the actual input combinations in use, can be specified, once again, in the class of power transformations as :

$$(\log K)^d = a + b (\log L)^d \qquad \ldots(2)$$

where d is the power used in the transformation. If d = 1 then, this form is identical to the best practice expansion path (Eqn. 1). Any value of

d different from unity indicates a deviation from 'rationality'. An approximate 95% confidence interval for the estimated value of d can suggest whether the farms in question are operating under profit maximizing rationality or not. For details of these econometric methods see [9,11]. We will call the functional form (Eqn. 2) as general expansion path.

Tables 1-3 show the estimates of the general expansion path as well as the function specific best practice expansion path. All the required data are drawn from the Farm Management Studies. Two districts for two different crops are considered. The Ferozpur district data for 1968-69 on all crops (mainly wheat) on a sample of 150 farms and Tanjore district data for 1969-70 on a sample of 150 Paddy farms are utilized. In the analysis of Ferozpur data, labour is defined separately as man-hours and wages in rupees on both hired and imputed family labour. For capital, instead of taking actual fixed or working capital, the interest (including imputed) on fixed and working capital is used. For Tanjore district labour is taken only as man-days, and for capital once again, the interest on fixed and working capital are used. For purposes of examining economies of scale, farms are grouped into several sub-groups of farm sizes. All the data are expressed as per acre of farm size.

The general expansion path (Eqn. 2) is estimated by the maximum likelihood method [11], whereas, for the form (Eqn. 1), ordinary least squares method modified for errors in variable case is employed. (See appendix for further details).

Noticeably, in all cases (of different farm sizes and different crops) the observed expansion path is quite different from the hypothetical best practice expansion path. The maximum likelihood estimate of d is zero in all the cases. Then the estimated general expansion path based on observed farm level data can be written as :

$$\log (\log K) = a + b \log (\log L) \qquad \ldots(3)$$

Even the 95% confidence interval for the estimate of d does not include unity. Clearly, in both cases (i.e. Ferozpur and Tanjore district) rationality is difficult to assertain. More striking is the fact that both large as well as small farms are away from allocatively efficient behaviour. Thus, with a production specification in the class of power functions and a general imperfect market specification, farms are found to be operating

Table 1: Estimates of Best Practice Expansion Path, General Expansion Path and Input Efficiencies

Ferozpur District : 1968-69 : All Crops Data

Size of farm : gross cropped area hectares	*No. of farm samples*	*Best Practice Expansion Path* $d=1 : \log K=a+b \log L$					*Observed Expansion Path* $d=0 : \log \log K=a+b \log \log L$	
		$\hat{a}$	$\hat{b}$	$\hat{P}_1$	$\hat{P}_2$	$\hat{P}$: Wise-Yotopoulous index	$\hat{a}$	$\hat{b}$
0-5	10	5 757	0.127	0.916	0.149	0.369	0.895	0.105
5-10	40	5.257	0.240	0.875	0 288	0.502	0.307	0.693
10-15	35	4.904	0.331	0.868	0.419	0.603	0.250	0.750
15-20	29	5.014	0.299	0.858	0.351	0 548	0.429	0.571
20-30	25	5.352	0.178	0.964	0.458	0.664	0.586	0.414
30-50	11	5.368	0.127	0.761	0.049	0.192	0.620	0 380
All farms	150	5.244	0.230	0.872	0.265	0.481	0 807	0.193

Notes : The maximum likelihood estimate of d is zero.

L = labour in man-hours

K = interest on fixed and working capital

P_1 = index of rationality of labour

P_2 = index of rationality of capital

P = index of total rationality

Table 2 : Estimates of Best Practice Expansion Path, General Expansion Path and Input Efficiencies

Ferozpur District : 1968-69 : All Crops Data

Size of farm : gross cropped area in hectare	*No. of farm samples*	*Best Practice Expansion Path* d=1 : log K=a+b log L					*Observed Expansion Path* d=0 : log log K=a+b log log L	
		$\hat{a}$	$\hat{b}$	$\hat{P}_1$	$\hat{P}_2$	$\hat{P}$=Wise-Yotopoulous index	$\hat{a}$	$\hat{b}$
0- 5	10	5.302	0.126	0.873	0.098	0.2923	0.882	0.118
5-10	40	5.028	0.173	0.851	0.145	0.3510	0.256	0.744
10-15	35	4.441	0.331	0.831	0.349	0.5 84	0.307	0.693
15-20	29	4 950	0.202	0.836	0.172	0.3794	0 404	0.596
20-30	25	5.257	0.085	0.864	0 044	0.1952	0.500	0.500
> 30	11	5.652	-0.035	0.7 0	0.004	-0.0542	0.511	0.489
All farms	150	4.996	0 175	0.833	0.133	0.3334	0.829	0.171

Notes : The maximum likelihood estimate of d is zero.

L = wages to the labour (in Rs.)
K = interest on fixed and working capital
P_1 = index of rationality of labour
P_2 = index of rationality of capital
P = index of total rationality

Table 3 : Estimates of Best Practice Expansion Path, General Expansion Path and Input Efficiencies

Tanjore District : 1969-70 : Paddy Crop Data

Size of farm : gross cropped area in hectare	*No. of farm samples*	*Best Practice Expansion Path* For d=1 : log K=a+b log L					*Observed Expansion Path* log d=0 : log K=a+b log log L	
		$\hat{a}$	$\hat{b}$	$\hat{P}_1$	$\hat{P}_2$	$\hat{P}$=Wise-Yotopoulous index	$\hat{a}$	$\hat{b}$
0-1	64	4.7570	0.1312	0.906	0.143	0.3599	0.5756	0.4204
1-2	36	4.6934	0.1143	0.849	0.068	0 2409	0.5968	0.4032
2-3	16	4.9281	0.0193	0.928	0.005	0.0668	0.9259	0.0741
2-5	22	4.9007	0.0253	0.933	0.009	0.0909	0.5000	0.5000
All size $\leqslant 5$	122	4.8021	0.0929	0.887	0.064	0.2378	0.5228	0.4772

Notes : The maximum liklihood estimate of d is zero.

L = labour in man-days
K = interest on fixed and working capital
P_1= index of rationality of labour
P_2= index of rationality of capital
P = index of total rationality

away from profit maximizing levels of input combinations.

Wise and Yotopoulous [10] suggest a measure of 'total rationality' as the correlation coefficient between log capital and log labour. The farms are said to be allocatively rational if the correlation coefficient is unity. The correlation away from unity represents irrationality. The tables 1-3 also show the estimated Wise and Yotopoulous index of rationality. The following general remarks can be made on the index of rationality : (a) Invariably, the correlations are far from unity in both the data. (b) In case of Ferozpur all crops farms, the degree of efficiency increases as the size of farm increases upto some level and then the efficiency declines. (c) In case of Tanjore paddy farms, the efficiency is highest (though insignificant) on farms of less than one hectare in size and the degree of efficiency declines sharply as the farm size increases.

One of the first questions that arises is, what are the factors for such irrational use of farm inputs. The method for an identification of factors responsible for the deviation is as difficult as that for price and technical efficiency. The total inefficiency is a result of inefficiencies in allocating each of the farm inputs. Let us assume that the deviations of actual inputs from the hypothetical levels can be identified as :

$$\left.\begin{aligned} \log K &= \log K^* + e_1 \\ \log L &= \log L^* + e_2 \end{aligned}\right\} \quad \ldots(4)$$

where K^* and L^* are hypothetical efficient levels of capital and labour respectively under the rationality criterion. Then e_1 and e_2 are measures of individual contributions to irrationality in the use of capital and labour respectively. They are the deviations of actual inputs away from the best practice levels of inputs. Then we define, two indices of rationality as :

$$P_1 = \frac{\text{Var } (\log L^*)}{\text{Var } (\log L)} \quad : \text{ Index of Rationality of Labour}$$

$$P_2 = \frac{\text{Var } (\log K^*)}{\text{Var } (\log K)} \quad : \text{ Index of Rationality of Capital}$$

$$= \frac{b^2 \text{ Var } (\log L^*)}{\text{Var } (\log K)} \quad \ldots(5)$$

It can be easily seen from (Eqn. 4) with suitable assumptions on the deviations e_1 and e_2 (see appendix), that both the indices of rationality are less than or equal to unity. Under the case of total rationality when inputs are used along the best practice expansion path, these individual indices of rationality become unity. In case of irrational allocation of inputs they are strictly less than unity.

The estimates of P_1 and P_2 are also shown in Tables 1-3. These estimates conclusively suggest the following :

(a) The two rationality indices P_1 and P_2 differ greatly, implying that the Indian farmers allocate or (misallocate) the two inputs based on different rationalities, trying to employ one of them more efficiently than the other. In that sense farmers are not totally indifferent in their attitudes in employing their scarce inputs.

(b) Between the two inputs, the labour is employed relatively more efficiently than capital inputs.

(c) The inefficiency in the use of capital equipment does not show any remarkable improvement with large farms. In fact, in case of Ferozpur, efficiency of capital use rises initially and then decreases substantially for farms of greater than 30 hectares in size.

(d) The indices of rationality of capital in Tanjore district are extremely low as compared to labour. However, in Ferozpur district they are substantially higher.

Conclusion

Our analysis in the previous section helps to draw certain specific conclusions. As far as total allocative efficiency is concerned, the divergence from profit maximizing input combinations is evident. It is then logical to examine the factors responsible for such misallocation of resources. Several questions can be raised : Are all the inputs uniformly misused ? Is the irrationality uniform between farms of all sizes ? Are there divergencies in efficiency between different crops ? We go into these questions briefly.

The estimated general expansion path being log log linear as shown in

equation 3, suggests that the expansion path bends towards labour indicating the limitations due to shortage of capital and thus, substituting with surplus labour. But are the farmers employing their surplus labour in a rational way ? The answer seems to be in affirmative. The estimates of rationality indices of labour are substantially higher and close to unity than that of capital. This indicates their efforts to adjust the labour inputs more efficiently. If capital were as readily available as labour, they would have adjusted their inputs along the best practice expansion path. This reflects imperfections in capital market with high capital costs. Thus the farmers, continue to substitute labour for capital in their bid to increase output. A major component of their labour is family labour. It is the divisibility of family labour that suggests greater efficiency in their use between farm and non-farm activities.

The decline in allocative efficiency with large farm holdings (as measured by the index of 'total rationality' of Wise and Yotopoulous) is apparent in most farm management studies. Raj Krishna [6] points out that the decline in output per acre acts against the case for large farm holdings. The major factor for this increasing degree of inefficiency of large farms seems to be not in the allocation of labour but in capital itself. The sharp decline of index of rationality for capital after certain sizes suggests that operationally, capital cannot be managed properly on farms beyond certain sizes. Even the efficiency of labour is found to decline beyond certain sizes, though relatively only marginally. However, this paper cannot fully answer the question on what is the optimum size of farm. We are aware of the limitations of data from farm management studies.

Between the two crops considered, wheat farms are more efficiently managed than the paddy farms. This conclusion again is warranted in view of the data used.

In conclusion, it is apparent that even though Indian farms are somewhat inefficient in their input use, the farmers are employing their labour more rationally than their capital equipments. The degree of irrationality can be explained in terms of price rigidities and monopoly elements in capital availability. The variation in the factor efficiencies for different farm sizes needs further study before any positive conclusion on the relation between size and efficiency can be made.

Appendix

(A) Derivation of Expansion path :

The production function be defined in the class of power families as :

$$X^r = a_1 L^r + a_2 K^r$$

where X = output per unit of land, L = labour employed per unit of land, K = capital per unit of land, and a_1, a_2, r are parameters.

Note that as $r \to o$, the production function takes Cobb-Douglas form. Otherwise, it is in the class of *CES* form.

Let the market conditions be specified as :

$$L = l_o\, w^{l_1} \quad : \text{ Labour supply}$$
$$K = k_o\, t^{k_1} \quad : \text{ Capital supply}$$
$$X = g_o\, p^{-g_1} \quad : \text{ Demand for output}$$

} Imperfect Market Specification

where w = wage rate, t = interest rate, p = price output, l_o, l_1, k_o, k_1, g_o and g_1 are constants. It can be shown that, profit maximization conditions allow to derive the expansion path as :

$$d_1\, L^{*\,C-r} = d_2\, K^{*\,B-r}$$

where d_1, C, d_2, B are constants, functions of other constants in the market specification and production function. The starred values of L and K stand for efficient levels.

Hence, the expansion path can also be written as :

$$\log K^* = a + b \log L^*$$

where $a = \log \left(\frac{d_1}{d_2} \right)^{\frac{1}{B-r}}$; $b = \frac{C-r}{B-r}$

(B) Indices of rationality :

The observed levels of inputs deviate from the expected levels under profit maximization conditions. This can be stated as :

$$\log K = \log K^* + e_1$$

$$\log L = \log L^* + e_2$$

where, e_1 and e_2 are the measures of inefficiencies (misallocations) in respective factor inputs. Assume :

$$E(e_1) = E(e_2) = 0$$

$$\text{Var}(e_1) = \sigma_2 \quad \text{Var}(e_2) = \sigma_2^2$$

$$\text{Cov}(e_1 e_2) = 0$$

Then it can be shown that :

$$\text{Var}(\log K) = \text{Var}(\log K^*) + \sigma_1^2$$

$$\text{Var}(\log L) = \text{Var}(\log L^*) + \sigma_2^2 = b^2 \text{Var}(\log K^*) + \sigma_2^2$$

$$\text{Cov}(\log K, \log L) = b \text{ Var}(\log K^*)$$

Wise-Yotopoulous [10] index of 'total rationality' is defined as :

$$P = \frac{\text{Var}(\log K^*)}{\text{Var}(\log K)} = \frac{\text{Var}(\log L^*)}{\text{Var}(\log L)}$$

We define individual factor use rationality as :

$$P_1 = \frac{\text{Var (log } L^*)}{\text{Var (log } L)} \quad : \text{ Rationality Index for Labour}$$

$$P_2 = \frac{\text{Var (log } K^*)}{\text{Var (log } K)} \quad : \text{ Rationality Index for Capital}$$

It can be easily seen that : $0 \leqslant P_1, P_2, P \leqslant 1$

(C) Estimation of general expansion path :

The general expansion path is defined as :

$$(\log K)^d = a + b\ (\log L)^d$$

Since both labour and capital are subjected to misallocation errors, this is a non-liner error in variable model. The log likelihood function (log M) of the combined errors for any given value of d can be written as [9]:

$$\log M\ (d) = -\frac{N}{2} \log \hat{\sigma}_1^2\ (d) - \frac{N}{2} \log \hat{\sigma}_2^2\ (d)$$

$$+ (d-1) \sum_{i=1}^{N} \left[\log \log L_i + \log \log K_i \right]$$

$$+ 2N \log |d|.$$

where $\hat{\sigma}_1^2$ and $\hat{\sigma}_2^2$ are least squares estimates of σ_1^2 and σ_2^2.

The general expansion path is estimated for an assigned value of d as :

$$\hat{a} = \overline{(\log K)^d} - \hat{b}\ \overline{(\log L)^d}$$

$$\hat{b} = \frac{-[\text{Var}(\log L)^d - \text{Var}(\log K)^d] + \sqrt{[\text{Var}(\log L)^d - \text{Var}(\log K)^d]^2 + 4\,\text{Cov}[(\log L)^d (\log K)^d]}}{2\,\text{Cov}[(\log L)^d (\log K)^d]}$$

$$\hat{\sigma}_1^2(d) = \text{Var}(\log L)^d - \frac{\text{Cov}[(\log L)^d (\log K)^d]}{\hat{b}}$$

$$\hat{\sigma}_2^2(d) = \text{Var}(\log K)^d - \hat{b}\,\text{Cov}[(\log L)^d (\log K)^d]$$

The maximum of log M in the range of $-\infty < d < \infty$ is determined in an iterative manner, yielding the maximum likelihood estimate of d.

Approximate 95% confidence intervals $(U_1 - U_2)$ for $\hat{d}$ are defined as :

$$\log M(\hat{d}) - \log M(U_1) \leqslant \tfrac{1}{2}\chi^2_{0.05} = 1.92$$

$$\log M(\hat{d}) - \log M(U_2) \leqslant \tfrac{1}{2}\chi^2_{0.05} = 1.92$$

where U_2 and U_1 are the upper and lower limits of the interval.

The expansion path under profit maximizing conditions is estimted treating d=1. Hence the two indices of rationality can be estimated as :

$$\hat{P}_1 = \frac{\text{Cov}[\log K, \log L]}{\hat{b}\,\text{Var}(\log L)} \qquad \hat{P}_2 = \frac{\hat{b}\,\text{Cov}[\log K, \log L]}{\text{Var}(\log K)}$$

The index of total rationality is same as the correlation coefficient between log K and log L.

(D) Properties of general expansion path : The two derivatives of the function are :

$$\frac{d \log K}{d \log L} = b \left(\frac{\log L}{\log K}\right)^{d-1}$$

$$\frac{d^2 \log K}{d \log L^2} = b\,(d-1) \left(\frac{\log L}{\log K}\right)^{d-1} \frac{a}{(\log K)^{d+1}}$$

Hence, (a) if $d=1$: the expansion path is a straight line in log K, log L.

(b) if $d>1$: the expansion path rises towards log K axis.

(c) if $d<1$: the expansion path bends towards log L axis.

REFERENCES

1. Dey, A.K. and Rudra, A. "A Test of Hypothesis of Rational Allocation Under Cobb-Douglas Technology". *Economic and Political Weekly*, Vol. VIII, No. 12, March 24, 1973.
2. Dillon, J.L. and Anderson, J.R. "Allocative Efficiency, Traditional Agriculture, and Risk," *American Journal of Agricultural Economics*, Vol. 53, No. 1, Feb. 1971 : 26-32.
3. Farrel, M.J. "Measurement of Productive Efficiency". *Journal of Royal Statistical Society*. Vol. 120, 1957, 253-82.
4. Hopper, W.D. "Allocation Efficiency in a Traditional Indian Agriculture". *Journal of Farm Economics*, 47, August, 1965 : 611-624.
5. Lau, L.J. and Yotopoulous, P.A. "A Test for Relative Efficiency and Application to Indian Agriculture". *American Economic Review*, March 1971 : 94-109.
6. Krishna Raj "The Optimum Firm and the Optimum Farm". *The Economic Weekly*, October 6 and Oct. 13, 1962.
7. Rudra, A. "Allocative Efficiency of Indian Farmers : Some Methodological Doubts". *Economic and Political Weekly*, Vol. 8 No. 3, Jan. 20, 1973 : 107-112.
8. Sahota, G.S. "Efficiency of Resource Allocation in Indian Agriculture". *American Journal of Agricultural Economics*, 50. Aug. 1968 : 584-605.
9. Tintner, G and Kadekodi G. "Note on the Transformations of Variables in Simultaneous Equations Systems". *Journal of Indian Society of Agricultural Research and Statistics* Vol. 23, Dec. 1971 : 1963-173.
10. Wise, J and Yotopoulous, P.A. "The Empirical Content of Economic Rationality : A Test for a Less Developed Economy". *Journal of Political Economy* No. 1969 : 976-1003.
11. Zarembka, P. "Transformation of Variables in Econometrics", *Frontiers in* Econometrics, edited by Zarembka, P., Academic Press, 1974.

Tractorisation and Farm Productivity

R.K. Sharma

It is now widely recognised that the ever-increasing unemployment is the most intractable problem facing the underdeveloped countries and therefore, these countries should go in for labour-intensive technology for their development[1]. In a situation of increasing unemployment, the introduction of tractors will only mean the "replacement of increasingly abundant workers by increasingly costly machines"[2]. On the other hand, there is a strong opinion in favour of tractorisation[3]. The advocates of tractorisation argue that the replacement of the inefficient bullock technology by tractors is essential, not only for rapid agricultural development, but also for increasing farm employment. Tractorisation, it is argued, will also help in increasing farm output, which, in turn, will create additional jobs in agriculture as well as in non-agricultural sector (viz., processing of farm products, manufacture, sales and servicing of machinery and other farm inputs like fertilizers and pesticides). The validity of this argument crucially rests on the assumption that the increase in farm productivity will be large enough to more than netraulise the labour-saving effects of tractorisation. Unfortunately, very little evidence has been produced to substantiate this hypothesis, largely because, very few systematic studies have been carried out in this country to study the impact of tractorisation on farm output and employment.

The objective of this paper is to analyse the available data in order to study the impact of tractorisation on farm productivity. This paper is largely based upon a detailed study[4] recently completed by the author. At the end, the results of this study are compared with the findings of few recent studies on tractorisation in the same region (viz. Punjab and Haryana). The analysis is confined to these states because they show the maximum concentration of tractors in India. It may be noted that about 40% of the tractors in the country are found in these two states, while they account for only about 5% of the cultivated area of the country.

Productivity Differences Between Tractor and Bullock Farms

The impact of the tractorisation on productivity can be known either by studying a group of tractor farms before and after the introduction of tractor, or by a comparative study of a group of tractor farms with a 'comparable' group of bullock farms. The first method is an ideal one for studying the process of change in farming due to tractors. However, this method is more expensive and time-consuming than the other because in order to fully capture the impact of tractorisation such a study would have to be spread over a period of three to four years. Therefore, all the major studies of tractorisation in India have adopted 'cross-section' approach for analysing the impact of tractorisation on farm productivity. The present study is based upon data collected from a sample of 50 tractor farms and 30 bullock farms which were purposively selected from a homogeneous region in Karnal district of Haryana. The farms were selected purposively in order to ensure that the tractor and bullock farms are similar at least in terms of two basic resources, namely cultivated area and irrigated area. It may, however, be noted that by and large, tractorisation is confined to resourceful and 'progressive' farmers, This fact has to be kept in mind while comparing the performance of the tractor farms with that of bullock farms.

Table 1 presents the data on farm productivity on the selected tractor and bullock farms in Karnal. Productivity has been measured in terms of the value of gross crop output per acre because in a 'land-scarce' and 'labour-surplus' economy output per acre is the most appropriate measure of productivity. In addition, the table also gives data on average yield per acre of two mojor crops (viz. wheat and paddy) grown in the region.

Table 1: Output on Selected Tractor and Bullock Farms in Karnal (1970-71)

Particulars	*Tractor Farms*	*Bullock Farms*	*Percentage Difference*
Gross Output (Rs.)			
Per Cultivated acre	1273	1084	17
Per Cropped acre	723	644	12
Average Yield per acre (*Kg.*)			
Wheat	1101	1027	7
Paddy	1210	1068	13

It is evident from table 1 that (a) tractor farms show about 17% higher output per cultivated acre than bullock farms and (b) tractor farms also show a marginally higher yield of both wheat and paddy.

Contribution of Tractors to Productivity

Let us now turn to the vital question, namely, how much of increased output on tractor farms can be attributed to the use of tractors ? In order to answer this question, it is necessary to work out (a) the role of tractors in the use of various inputs and (b) the contribution of these inputs to the total crop output. Given the complexities of agricultural production, both of these present intractable problems. For instance, only specific field experiments can precisely show the extent of increase in output resulting from an increase in the number of ploughings or due to a shift from bullock to tractor ploughings. Therefore, it has not been possible to work out the precise contribution of tractors in increasing output on tractor farms. All that can be done on the basis of limited sample data is to broadly indicate the role of tractors in increasing farm output.

Table 2 : Basic Data on Selected Tractor and Bullock Farms in Karnal District

Particulars	*Tractor Farms*	*Bullock Farms*
1. Number of Farms	50	30
2. Average farm size	29.53	29.44
3. Percentage area irrigated	100	100
4. Percentage irrigated area by owned Tube-wells/Pump sets.	89	82
5. Cropping intensity	176	167
6. Value of fertilizers per acre (Rs)	144	99
7. Percentage area under :		
a) Wheat	42.03	42.38
b) Rice	17.97	21.44
c) Other cereals and pulses	11.67	13.00
d) Sugarcane	11.72	7.09
e) Fodders	10.16	11.93

If the selected tractor and bullock farms were identical in terms of resources one could clearly state that the additional output on tractor farms was due to the use of tractors. However, this is not so. As stated earlier, tractorisation is largely confined to resourceful and progressive farmers, who can afford to make a larger use of modern inputs, specially fertilizers and irrigation from assured sources (viz. own tube-wells and pump sets). Therefore, in spite of our efforts to ensure the selection of comparable farms the selected tractor farms turned out to be somewhat better in respect of irrigation facilities. Table 2 shows that although the tractor farms are similar to bullock farms in respect of irrigated area, they have larger irrigation from owned tube-wells. Partly as a result of this, and partly due to their resourcefulness, they were able to make significantly higher (45%) use of fertilizers per acre as compared to the bullock farms. Moreover, better irrigation facilities helped tractor farmers to marginally increase their cropping intensity as compared to bullock farmers. Since the cropping pattern on both the groups of farms is about the same (table 2), it appears that the larger output on tractor farms is due to their better irrigation facilities and larger use of fertilizers.

In order to test the above hypothesis sample data (of 80 comparable farms) was subjected to statistical testing. Cobb-Douglas function was tried with gross crop output per cultivated acre (y) as the dependent variable and the following independent variables :

X_1—Tractor dummy ;

X_2—Average weighted number of irrigations* per cultivated acre ;

X_3—Value of fertilizers per cultivated acre ;

X_4—Cropping intensity.

The results (Page 623) confirm the hypothesis that the differences in output per acre between different farms are due to factors other than the use of tractor.

* This has been calculated in the following manner. At first gross irrigated acres of each plot sown during a season were worked out by multiplying the plot size with number of irrigations. The gross irrigated acres of all the plots sown during the two seasons were added to arrive at the gross irrigated acres of each farm. Average number of weighted irrigations were then worked out by dividing gross irrigated acres by cultivated area.

$$Y = 2.3029 + \underset{(0.0387)}{0.0215\ x_1} + \underset{(0.0839)}{0.1856^{*}\ x_2} + \underset{(0.0601)}{0.2165\ x_3} + \underset{(0.1526)}{0.6201^{R}\ x_4}$$

(R-Significant at 5% level)

$(N = 80;\ R^2 = 0.63;\ \bar{R}^2 = 0.61;\ F\ \text{Value} = 31.93).$

Reasons for the Negligible Impact of Tractors

Why is it that tractorisation has not helped in increasing farm productivity ? We shall now examine the available data to answer this question. Productivity per acre is a function of various factors, of which three important ones are :

(a) Cropping intensity,

(b) Crop pattern, and

(c) Crop yields.

Let us first consider cropping intensity and crop pattern. The overlapping of the kharif harvesting season with the Rabi sowing puts a severe strain on animal draught power as well as human labour on bullock farms. The important kharif crops are harvested in the months of October and November which is also the period during which the fields are prepared for wheat, the main Rabi crop. Farmers dependent upon the slow moving and labour intensive bullock power find it very difficult to carry out the kharif harvesting operations and Rabi sowing simultaneously. Generally, the wheat fields are given about six to eight ploughings, and the bullock farmers find this operation difficult to execute during the period of about a month between the kharif harvesting and the Rabi sowing. As a result, some farmers are unable to cultivate all the land that is released from kharif crops. In order to maximise the area under wheat and also to recoup soil fertility, many farmers keep some land fallow in kharif for sowing wheat in the Rabi. Such fields are well ploughed during the fallow period (In some cases for as many as 15 times). The availability of the Mexican varieties of wheat, some of which can be sown as late as the last week of December, has lengthened the interval between the kharif harvesting and the Rabi sowing. However, the bullock farmers still remain very hard pressed during this period. In such a situation, the use of tractors could perhaps be the

answer to the problem of peak demand for draught power and human labour leading to increase in cropping intensity and some changes in the cropping pattern. However, the data on cropping intensity, given in Table 2 shows that the cropping intensity on tractor and bullock farms is about the same. It may be mentioned that during the Rabi, main cropping season in the region, bullock farmers are able to achieve a cropping intensity equal to that on tractor farms.

The relatively small difference in cropping intensity between the two groups of farms can be largely explained by two factors. Firstly, draught power is only one of the several factors which determine cropping intensity. Beyond a point, other factors, irrigation in particular, are more important constraints on increasing the intensity of cropping. Secondly, (a point already mentioned), with the introduction of Mexican wheat, the interval between the summer harvesting and winter sowing has been lengthened giving the bullock farmers more time for carrying out of the tillage operations for wheat. Thus, it would seem that the use of tractors has helped farmers more in reducing the drudgery and pressure of work during the peak season than in increasing cropping intensity.

Table 2 also shows that the cropping pattern on tractor and bullock farms is almost similar. In particular, it may be noted that the proportion of area under high-yielding varieties of wheat is also the same for both the groups of farms. Thus, the assertion that the use of tractors is essential for the cultivation of high-yielding varieties is not supported by the findings of this study.

As regards crop yields, it is rightly argued that tractors can increase crop yields by ensuring proper tillage at the right time. However, in practice, these advantages of tractorisation have not been realised. A recent analysis of several empirical studies on mechanisation in Asian and Latin American countries has concluded that "it is not clear that mechanisation of itself has any yield increasing effects".[5]

Conclusion

The results of this study clearly show that tractorisation has negligible impact on productivity. However, one should not draw firm conclusions

on the basis of one study. Therefore, before concluding we, shall compare the results of this study with those of other recent studies on tractorisation in the region comprising Punjab and Haryana.

The results of a detailed study recently completed by the Economic Adviser to the Government of Punjab are summarised in Table 3. (The study covered the entire State). It may be noted that as compared to bullock farms the tractor farms show about 18% higher output per acre, marginally higher cropping intensity and slightly larger proportion of area under high-yielding wheat. Although the data have not been statistically analysed, the larger output on tractor farms appears to be due to better irrigation facilities and larger use of fertilisers. In the case of fertilisers the study concludes : "Higher per acre expenses on fertilisers by tractor cultivators can be attributed to their affluence and higher capacity to purchase inputs".

Table 3 : Results of Punjab Study (1970-71)[6]

Particulars	*Bullock Farms*	*Tractor Farms*
1. Number of farms	83	115
2. Average farm size (acres)	26.73	37.37
3. Percentage area irrigated	88	90
4. Percentage of gross irrigated area by tube-wells/Pump sets	44	54
5. Cropping Intensity	135	148
6. Value of output per cultivated acre (Rs.)	851	1003
7. Value of fertilisers per acre (Rs.)	57	83
8. Percentage wheat area under high-yielding varieties	89	96

The Farm Management Survey[7] in Ferozepore district also shows similar results; tractor farms have higher productivity but statistical analysis of the data show that the increases in productivity are due to factors other than the use of tractors.[8] The study on the cost of production of wheat in Punjab and Haryana[9] also show that the average yield per hectare is about the same on tractor and bullock farms, as is evident from the following data.

Average Yield of Wheat (Per hectare)

	Punjab (1970-71)	*Haryana (1970-71)*
Tractor Farms	24.64	23.14
Bullock Farms	24.39	22.69

Thus, the available data clearly shows that, so far, tractorisation has made negligible impact on farm productivity. One can, therefore, conclude that developmental efforts should be concentrated on increasing irrigation facilities and the use of fertilisers.

REFERENCES

1. Clayton, Eric S. — "A Note on Farm Mechanisation and Employment in Developing Countries." *International Labour Review* Vol. 110, No. 1, July 1974.
2. Bell, C. — "Landlords, Landless and the Distribution of Income" (Institute of Development Studies, University of Sussex, 1971; Mimeographed)
3. Johl, S.S. — "Mechanisation, Labour Use and Productivity in Agriculture", Agricultural Situation in India, Vol. XXVIII No. 1, April, 1973.
4. Sharma, R.K. — "The Economics of Tractor Cultivation : A Study in Karnal District, Haryana". Agricultural Economics Research Centre, University of Delhi, 1974. (Mimeographed)
5. Stitzlein, John W. — "The Economics of Agricultural Mechanisation in Southern Brazil", Ohio State University, 1974 (Mimeographed)
6. The Economic Adviser to the Government of Punjab — "Economics of Tractor Cultivation and Economics of Production and Cultivation Practices of High Yielding Varieties of Wheat, Maize and Paddy in Punjab : Report for the year 1970-71" Government of Punjab, 1973.
7. Kahlon, A.S., Miglani, S.S. and Mehta, S.K. — "Studies in Economics of Farm Management, Ferozepur District (Punjab) : Report for the Year 1969-70". Directorate of Economics and Statistics, Ministry of Agriculture, Govt. of India, 1974. (Mimeographed)
8. Vashishtha, Prem. — "An Econometric Study of the Effect of Tractorisation on Farm Output and Employment", Institute of Economics Growth, Delhi. 1973 (Mimeographed)
9. Dircetorate of Economics and Statistics — "Report on Cost of Production of Wheat in Haryana and Punjab during the 1970-71 Crop Season", Ministry of Agriculture, Govt. of India (Mimeographed).

Agricultural Productivity, Adoption of New and Small Farmers : An Inter-State Analysis

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The social and economic implications of the new agricultural technology in the Asian countries, particularly, the introduction of the high-yielding varieties of seeds and chemical fertilisers, have been a topic of discussion among analysts. Two schools of thought have come to stay, one conforming to the idea and the other viewing the success of agricultural technology critically. The followers of the first school are so overwhelmed by the 'success' of the new agricultural technology, that they firmly believe this to be the long-term solution to the Malthusian principle of rapid population growth far exceeding the production of foodgrains and, thus, leading to a perpetual food crisis. The followers of the second school, on the other hand, warn against the possibility of social and economic upheavals due to the distortion of existing production pattern and widening inequalities between the social and economic status of rich farmers on the one hand and small-marginal farmers and landless agricultural labourers on the other.[1]

However, both the schools agree that the introduction of new agricultural technology did make significant positive contribution to the agricultural production and productivity in several countries of Asia, including India. The index of food production in India, with triennium ending 1961-62 as base period, increased from just 89.9 in 1965-66 the year preceeding the adoption on a significant scale of new technology by the farmers to 117.1 in 1967-68 and 133.9 in 1970-71. Likewise, the index of foodgrains yield per unit of land increased from only 89.6 in 1965-66 to 113.5 in 1967-68 and 122.0 in 1970-71. The impact was much more pronounced in the case of wheat. The index of wheat production increased from 93.4 in 1965-66 to 148.7 in 1967-68 and 214.2 in 1970-71. The index of yield of wheat, too, showed significant increase from 98.7 in 1965-66 to 131.6 in 1967-68 and 164.7 in 1970-71.[2]

1. United Nations Research Institute for Social Development, *The Social and Economic Implications of Large Scale Introduction of New Varieties of Foodgrains*, Geneva, 1974.

2. Government of India, Ministry of Agriculture, Directorate of Economics and Statistics, *Agricultural Situation in India*, Vol. XXIX, No. 9, December 1974, p 697.

But, the overall impact of new technology on agricultural production and productivity could not be sustained beyond 1970-71. The index of production and yield for foodgrains as well as wheat started dwindling after 1970-71. In 1973-74, the index of foodgrains production stood at only 130.3, index of wheat production at 198.4, index of foodgrains yield at 116.7 and index of wheat yield at 138.2. As a result, the per-capita availability of foodgrains in India also declined in the wake of rapidly growing population. The declining trends in agricultural production and productivity have to be effectively checked and their directions reversed if the goal of bringing about a significant improvement in the general health and living standard of the people is to be realised. The importance of continuing adoption of more scientific and more productive methods of agriculture by the farmers, especially medium, small and marginal farmers, who constitute an overwhelming majority of total Indian farmers, can hardly be denied in achieving the above objective. Of equal importance is the need for a conscious public policy to ensure that the gains of new technology are not concentrated in the hands of rich farmers and favourable geographical locations and thus, lead to inter-group and inter-region social, economic and political tensions.

This paper aims at analysing the extent of knowledge and adoption of new agricultural technology by small farmers, their evaluation of its economic gains and factors that discourage non-adoptors from adopting new technology in India. The data used here pertain to the period 1970-71, i. e., about 5 years after the new technology was used on a large scale. These were collected by the National Sample Survey Organisation in its 25th round which covered the lowest 10 percent of the cultivating rural households. An overwhelming majority of these households are cultivating land below 5 acres. We therefore, consider them to fall in the category of small-marginal farmers.

Knowledge of New Technology

There are significant inter-state variations in the level of small farmers knowledge about new agricultural technology. The data on knowledge are discussed here under the following four main practices :

(i) improved varieties of seeds, (ii) chemical fertilisers, (iii) green manuring, and (iv) plant protection measures, e. g., pesticides, insecticides etc.

We may now analyse the variations in the extent of knowledge of improved agricultural practice in different states of India. The necessary data are available for only 9 Indian states. These states and average size of cultivated holdings of sample households are : Gujarat (1.94 acres), Madhya Pradesh (1.21 acres), Maharashtra (1.66 acres), Karnataka (1.61 acres), Orissa (0.65 acres), Punjab (2.75 acres), Rajasthan (2.63 acres) Tamil Nadu (0.68 acres) and Uttar Pradesh (0.81 acres). It is indeed very intriguing that the tabulation plan for other states has been given up by the NSS Organisation, although the data collected during the 25th round are undoubtedly useful.

(*i*) *Improved Seeds* : The Punjab emerges at the top of all other states in terms of all the four agricultural practices. As many as 93.2 percent of its small farmers are reported to have knowledge of improved varieties of seeds (Table 1). This is quite expected in view of widespread adoption of these seeds in Punjab during the 5 years period preceding the NSS round. Significantly, Uttar Pradesh comes next with 62.5 percent of its farmers having been aware of improved seeds. Rajasthan is the only other northern state of India for which the data are available and 44 percent of small farmers there know about improved seeds. The two southern states of Karnataka and Tamil Nadu show that 45.2 and 43.2 percent of their small farmers are aware of improved seeds. The two western states of Gujarat and Maharashtra are very close to each other on this criterion : nearly 36 percent of their small farmers are aware of improved seeds. Only 12 percent of the small farmers in the eastern state of Orissa are reported to be so aware.

Table 1

Percentage of Small Farmer Households Having Knowledge of New Agricultural Technology in India, 1970-71

States	*Knowledge of Practices*				
	Improved seeds	*Chemical fertilisers*	*Green Manuring*	*Plant protection*	*Others*
Gujarat	36.2	37.4	13.6	18.6	0.3
Madhya Pradesh	27.5	31.1	14.3	17.4	4.7
Maharashtra	36.0	25.5	15.4	21.7	1.7
Karnataka	45.2	43.8	43.4	37.9	10.4
Orissa	12.0	12.1	5.8	9.1	1.8
Punjab	93.2	94.1	71.5	65.2	6.3
Rajasthan	43.9	36.5	22.2	23.4	3.4
Tamil Nadu	43.2	49.7	39.1	42.1	5.1
Uttar Pradesh	62.5	64.6	43.0	28.9	10.6

Source : National Sample Survey Organisation, New Delhi.

(ii) *Chemical Fertilisers :* Nearly 94 percent of small farmers in the Punjab have the knowledge of chemical fertilisers. They are followed by Uttar Pradesh where 64.6 percent small farmers have that knowledge. In Rajasthan, the proportion of such farmers stands at only 36.5 percent. Nearly 50 percent of the farmers in Tamil Nadu and 44 percent in Karnataka, too, are aware of chemical fertilisers.

(iii) *Green Manures :* This practice is less known to small farmers than improved seeds and chemical fertilisers. The pattern of inter-state variations is similar to that observed in the case of improved seeds and chemical fertilisers. The largest proportion of small farmers having knowledge of this practice is reported for the Punjab (71.5 percent) and the lowest for Orissa (5.8 percent). The extent of small farmers knowledge of green manuring is such higher in southern states of Karnataka and Tamil Nadu than in western states of Gujarat and Maharashtra, Central state of Madhya Pradesh and northern state of Rajasthan.

(iv) *Farm Protection Practices :* The level of knowledge of various farm protection practices such as insecticides, pesticides, weedicides etc. is still lower. On this measure, Punjab (65.2 percent) is followed by Tamil Nadu (42.1 percent) and Karnataka (37.9 percent). The small farmers in northern states of Uttar Pradesh and Rajasthan, however, show greater awareness of this practice than their counterparts in Gujarat, Maharashtra, Madhya Pradesh and Orissa

Level of Adoption and Economic Gains

The knowledge and actual adoption of new agricultural technology are positively associated. In other words, the percentage of small-marginal farmer households reporting full or partial adoption of various improved agricultural practices is higher in those states which show higher percentage of households having khowledge of those practices. Let us first consider the extent of non-adoption. There are four states where 50 percent or more of small-marginal farmers are reported to be pursuing only traditional agricultural practices and have not adopted the modern practices. These are : Maharashtra (61.0 percent), Orissa (60.8 percent), Madhya Pradesh (58.8 percent) and Rajasthan (50.1 percent). Significantly, these states have large drought prone areas. Another two states having large drought prone areas, viz, Gujarat and Karnataka also

show high proportion of non-adoption The relevant figures for these two states stand at 47.2 percent and 49.1 percent respectively (Table 2).

Table 2

Percentage Distribution of Small Farmer Households According to the Level of Adoption of New Agricultural Technology and Increase in Income

States	Level of Adoption			Increase in Income		
	Non-adoption	Full adoption	Partial adoption	Yes	No	Total
Gujarat	47.2	24.7	28.1	100.0	—	100.0
Madhya Pradesh	58.8	22.5	18.7	95.8	4.2	100.0
Maharashtra	61.0	18.7	20.3	88.2	11.8	100.0
Karnataka	49.1	14.4	36.5	84.9	15.1	100.0
Orissa	60.8	9.4	29.8	76.5	23.5	100.0
Punjab	16.4	46.5	37.1	96.0	4.0	100.0
Rajasthan	50.1	18.5	31.4	90.9	9.1	100.0
Tamil Nadu	11.6	51.1	37.3	67.9	32.1	100.0
Uttar Pradesh	27.1	31.3	41.6	85.2	14.8	100.0

Source : National Sample Survey Organisation, New Delhi.

It is significant to note that Tamil Nadu which ranks lower on the criterion of knowledge of new technology, occupies top position on the criterion of adoption. As many as 51 percent of small-marginal farmers in Tamil Nadu reported "full adoption" as compared to 46.5 percent in the case of Punjab Other states where 20 percent or more of small marginal farmers reported "full adoption" of improved agricultural practices are: Uttar Pradesh (31.3 percent), Gujarat (24.7 percent), and Madhya Pradesh (22.5 percent). In the case of Maharashtra and Rajasthan the proportion of "full adoption" stands around 15.5 percent. It, thus, appears that although a smaller proportion of small farmers in these states adopted improved agricultural practices, a large number of adopters adopted these practices fully. There is little inter-state variations in the percentage figures of "partial adopters" as between agriculturally developed and underdeveloped states

Most "full adoptors" of new technology are 'satisfied' with its results. All farmers in Gujarat, 99 percent in Punjab, 98 percent in Madhya Pradesh, 96 percent in Maharashtra, 94 percent in Rajasthan, 92 percent

in Uttar Pradesh and 91 percent in Karnataka, who are reported to be the full adopters are satisfied. The largest proportion of dissatisfied farmers (26 percent) is observed in the case of Tamil Nadu followed by Orissa (11.8 percent) and Karnataka (9.4 percent). The 'satisfaction' as used in the NSS survey, however, does not necessarily indicate higher economic returns. For, the available statistics suggest that in several states, the percentage of satisfied farmers is more than the percentage of farmers experiencing "substantial" increase in income due to the adoption of improved agricultural practices. In Punjab, where 99 percent farmers are satisfied with the adoption, only 96 percent experienced an increase in income. The Punjab is closely followed by Madhya Pradesh, 95.6 percent small farmers adopting new technology reporting positive impact on their income. The largest proportion of small farmers reporting no increase in their income after the adoption of new technology is observed for Tamil Nadu (32 percent). This is followed by Orissa (23.5 percent), Karnataka (15 percent), Uttar Pradesh (14.8 percent) and Maharashtra (11.8 percent).

The above discussion clearly suggests that the small and marginal farmers, having land size and fragmentation debilities, too, are quite receptive to the new technology. Once they overcome the initial obstacles in the way of their adoption of improved practices, most of them do well, are satisfied with its advantages and experience increase in their farm income. This is an encouraging finding and dispels some popular beliefs about the fate of small-marginal farmers in Indian agriculture. Proper understanding of the factors that facilitate and those that obstruct the adoption of new technology by these farmers and effective remedial measures to overcome the obstructions should enable them to derive full economic benefits of improved seeds, fertilisers, manuring and plant protection measures etc.

Besides the effectiveness of official extension work at the village level which is a crucial factor, the adoption of improved agricultural practices might be determined by several factors such as size of land holdings, education, tenurial conditions, income and assets structure etc.[3] The

3. V.S. Vyas *et al. Significance of the New Strategy of Agricultural Development for the Small Farmers,* Vallabh Vidya Nagar, 1969; and C. Rajagopalan and Jaspal Singh, *Adoption of Agricultural Innovations,* National Publishing House, New Delhi, 1971.

level of adoption is expected to be higher among the farmers whose land-holdings are relatively more. In particular, the farmers cultivating meagre land holdings of, say, less than 1 acre, are likely to have less capacity and chances of adopting improved practices than those with larger land-holdings. However, the level of adoption might decline after reaching a limit which might be different socio-economic and agronomic settings. It may also be hypothesised that the levels of knowledge and adoption are positively associated with the level of education, household income, assets and availability of irrigation facilities. Although the comparative inter-state data are not available, the hypothesis should normally be valid in almost all situations. The role of education and resourcefulness in adequately appreciating and actually adopting the results of scientific researches and innovations can hardly be over-emphasised.

Factors Hindering the Adoption

It is encouraging to note that a significant proportion of farmers in even those states that have lower level of adoption, have indicated scope for further improvement in intensive methods of cultivation and adoption of improved agricultural practices. As many as 71 per cent of the adopters in Gujarat reported room for further improvement. The percentages of households giving such response in other states are as follows : Punjab (50 percent), Karnataka (46.5 percent), Tamil Nadu (41 percent), Maharashtra (29.3 percent), Madhya Pradesh (28.2 percent), Uttar Pradesh (25.0 percent) and Orissa (22.5 percent). In the case of Rajasthan, however, not only the existing level of adoption is low but also only 2.2 percent of the adopters there reported scope for further improvement although 91 percent of them experienced substantial increase in income due to adoption. This necessitates an analysis of the factors that discourage them from fully adopting improved agricultural practices. The remaining part of this paper is aimed at identifying the relative importance of these factors.

The data available to us are aggregative of responses that were given by non-adopters and partial adopters. These are not available separately for the two groups of respondents. The reasons for non-adoption or partial adoption are classified under following four main heads :

(1) Do not know enough;

(2) Not convinced of benefits;

(3) Needed supplies not readily and timely available; and

(4) Own production finance not sufficient.

Lack of Knowledge : The want of adequate knowledge about various improved practices is stated to be an important factor which explains non or partial adoption of new agricultural technology. As many as 34.5 percent small farmers in Madhya Pradesh, 32.3 percent in Orissa, 31.3 percent in Rajasthan and 30.0 percent in Tamil Nadu did not fully adopt the new technology because they did not have enough knowledge of it. In fact, the Punjab is the only state where only 10.5 percent small farmers stated lack of knowledge as the main reason for non-adoption. In all other states, the percentage of farmers not adopting new technology due to this reason is about 20 percent or more. This highlights the ineffectiveness of official communication and extension sources and urgent need for improving upon these services.

Not Convinced of Benefits : This category covers two sub-categories, viz., promised production is not realised and cost too high, hence not profitable. Thus, the respondents whose responses are included here are those who have knowledge of the new technology, have either tried to adopt it and failed or are discouraged by the reported failure of others in their villages. This category of responses assumes added significance because the largest proportion of small farmers (about 40 percent) are concentrated here. Exactly one third of non or partial adopters of new technology in Punjab think that it does not give the "promised production". Next in importance comes Maharashtra (13.9 percent) which is followed by Gujarat (9.0 percent) and Rajasthan and Uttar Pradesh (about 8 percent). The prohibitive cost of new agricultural inputs (improved seeds, chemical fertilisers, insecticides etc.,) is not at all a factor in non-adoption in Punjab. This is, however, extremely powerful obstruction in the adoption of new technology in most other states. The highest figure (33.5 percent) is observed in the case of small farmers in Tamil Nadu followed by Uttar Pradesh (32.6 percent), Gujarat (30.0 percent), Maharashtra and Mysore (about 28 percent), Madhya Pradesh (27 percent) and Rajasthan (25.7 percent). These data, too, point at the need for more concerted agricultural extension and training activities to enable small farmers to make scientific use of this inputs to achieve the desired results.

Table 3

Percentage of Small Farmer Households Not Adopting or Adopting Only Partially the New Agricultural Technology by Reasons for Non-Adoption or Partial Adoption, 1970-71

Persons	*Gujrat*	*Madhya Pradesh*	*Maharashtra*	*Karnataka*	*Orissa*	*Punjab*	*Rajasthan*	*Tamil-Nadu*	*Uttar-Pradesh*
1. Do not know enough	26.9	34.5	25.8	25.2	32.3	10.5	31.3	30.0	19.7
2. Not convinced of benefits									
(i) Promised production is not realised.	9.0	5.3	13 9	7.3	6,1	33.3	8.3	5.9	8.0
(ii) Cost too high, hence not profitable	30.0	26.9	28.6	27.7	18.9	—	25.7	33.5	32.6
Sub-Total :	39.0	32.2	42.5	35.0	25.0	33.3	34.0	39.4	40.6
3. Needed supplies not readily and timely available.									
(i) seeds	8.2	0.9	10.8	1.0	7.3	0.9	6.6	4.4	6.2
(ii) fertilisers	2.6	0.3	0.7	—	1.8	—	3.0	1.0	0.8
(iii) seeds and fertilisers	4.5	0.9	3.9	2.2	1.2	0.9	7.9	2.9	5.1
(iv) others	7.5	16.7	4.6	6 7	9 8	0.9	6.9	7.6	9.0
(v) fertilisers and others	—	—	0.3	—	0.6	—	—	0.8	0.1
(vi) seeds and others	—	—	0.7	—	0.6	13.1	—	—	0.2
Sub-Total :	22.8	18.8	21.0	9.9	21.3	15.8	24.4	16 7	21.4
4. Own production finance not sufficient	11.3	14.5	10.7	29.9	21.4	40.4	10.3	13.9	18.3
Total :	100.0	100.0	100.0	100 0	100.0	100.0	100.0	100.0	100.0

Source : National Sample Survey Organisation, New Delhi.

Non-availability of Inputs : (i) seeds, (ii) fertilisers (iii) seeds and fertilisers (iv) other inputs, (v) fertilisers and other inputs, and (vi) seeds and other inputs.

The non-availability of seeds or non-availability of other inputs are the more important reasons for non-adoption or partial adoption. The data source does not specify what is covered under "other inputs". It might essentially mean non-availability of adequate assured irrigation, because the percentages of small farmers giving this response are higher in the states having more underdeveloped irrigation and drought-prone areas. These are : Madhya Pradesh (16.7 percent), Orissa (9.8 percent), Uttar Pradesh (9.0 percent), Tamil Nadu (7.6 percent), Gujarat (7.5 percent), Rajasthan (6.9 percent) and Karnataka (6.7 percent). The farmers in the states of Maharashtra (10.8 percent), Gujarat (8.2 percent), and Orissa (7.3 percent), also gave non-availability of improved seeds as an important reason for their failure to fully adopt new agricultural technology. If one considers all the respondents of item of non availability of needed supply together, from 10 percent small farmers in Karnataka to 24.4 percent in Rajasthan have not fully adopted the new agricultural technology due to this reason.

Financial Debilities : The successful adoption of costly improved agricultural practices is conditioned to a great extent by the financial self-sufficiency of the farmers. The role of credit in agricultural development, specially the development of small-marginal farmers has been emphasised from time to time. It is now widely accepted that the gains of the development could not benefit the small-marginal farmers because the organised credit lending institutions like commercial and cooperative banks were largely not within their reach.[4] The data being discussed here offers further confirmation to this thesis. These suggest that even those farmers who are probably convinced about the economic gains of new agricultural technology are unable to do so because their own production finance is not sufficient. It is significant to note that about 40 percent non or partial adopters of new technology even in developed state of Punjab have insufficient own production finance. A large proportion of

4. See : Reserve Bank of India, *Report of the All India Rural Credit; Review Committee*, Bombay, 1969, Government of India, National Commission on Agriculture, *Report on Credit Services for Small and Marginal Farmers and Agricultural Labourers*, New Delhi, 1971; and S.M. Pandey, *Development of Marginal Farmers and Agricultural Labourers*, New Delhi, 1974.

their counterparts in the southern state of Karnataka (29.9 percent) and the eastern state of Orissa (21.4 percent). too, do not practice improved agricultural technique essentially due to financial debility. Obviously, they are unable to get credit at reasonable rates of interest from credit lending institutions. The proportion of such small farmers in other states varies from 10.7 percent in Maharashtra to 18.3 percent in Uttar Pradesh. In view of the inflationary price rise of agricultural inputs and their short supply after 1970-71, the importance of financial debilities as a factor in non-adoption might have further increased.

Conclusions and Policy Implications

The study reveals that the small and marginal farmers have varying degree of knowledge of four main improved agricultural practices. With the exception of few states, nearly two-thirds of the small and marginal farmers know about improved seeds and chemical fertilisers. These, no doubt, are the two most crucial components of the new agricultural technology. The other two practices viz., green manuring and plant protection methods are not known so well to them. The small farmer's knowledge of various plant protection practices is particularly low in states other than the Punjab, Tamil Nadu and Karnataka.

The study suggests a clear positive association between farmers' knowledge of improved agricultural practices and their actual adoption by them. The level of adoption is higher in the case of those agricultural practices and states where more small farmers know of those practices. This further highlights the role of agencies responsible for agricultural extension activities in furthering the level of adoption, agricultural productivity and economic betterment of small-marginal farmers. There is a need for not only extending the geographical and population coverage of the extension activities but also improving upon their methods of communication to make it more effective and convincing the small-marginal farmers.

The study seriously questions the validity of the hypothesis that the small-marginal farmers, largely semi-literate or illiterate, belonging to lower castes and enjoying lower social and economic status, are not receptive to the results of scientific and technological innovations. Those who have adopted new technology have experienced substantial increase in income,

Those who would not have started increasing the productivity of their inputs by adopting improved methods of cultivation and making more intensive use of their meagre inputs. However, there are severe constraints on their actual adoption.

The major obstacles in the way of adoption of new agricultural technology by the small farmers are lack of adequate knowledge, unconvincing economic returns and non-availability of certain essential prerequisites and required inputs in time and on reasonable prices, and insufficiency of production finance. Inadequate knowledge of improved practices and doubts about economic return of the same among small marginal farmers seems to be largely due to their illiteracy on the one hand and ineffectiveness of official and voluntary extension services on the other. We have already pointed out the need to improve these services.

The non-availability in time of required quantity and quality of seeds, fertilisers and other inputs as well as serious financial debility, which together account for the non-adoption by more than one third of sample households reaffirms the weakness of official distribution machinery in rural areas which enable the resourceful larger farmers to corner the required inputs. These data clearly show that the cooperative and other organised credit lending institutions are beyond the reach of small-marginal farmers who have insufficient production finance to fully adopt improved agricultural practices.

Economies of Scale and Productivity Change in the Indian Manufacturing Industry

M.A. Oommen

The value of improved insights and understanding of the determinants of production and productivity is immense, especially for a developing economy like India. However, study of the economic relations of industrial production in India has tended to be a neglected field.

A few studies which have appeared on this problem were concerned with the industrial sector as a whole, based on cross-section data prior to Independence. The study of Murti and Sastry [5] was an exception. Their study relates to cross-section data for 1951 and 1952 and covers 7 groups of Industries. Their data were based on the balance sheet of a few firms. They did not have direct estimates of value added, man hours and capital stock. None of the previous studies made any attempt to measure productivity change using production function estimates. In this paper an attempt is made to estimate output elasticities and productivity change in the Indian manufacturing sector and the major agro-based industries using Cobb-Douglas production function.

The Census sector data of the Annual Survey of industry for the decade 1959-69 are used in this study. The Census sector covers all factories registered under the Indian Factories Act, 1948, which employed 50 or more workers with the aid of power or 100 or more workers without the aid of power Besides all manufacturing industries, the broad industry groups covered in this study are manufacture of dairy products (202), manufacture of grain mills products (205), manufacture of bakery products (206), sugar factories (207), manufacture of miscellaneous food preparations (209), tobacco manufacture (220) and textiles (231). Sometimes we have combined 202, 205, 206, 207 and 209 to make the Food Industry (200).[1] One sub-industry (the four digit category) viz., the

1. The numbers given in brackets give the International Industrial Classification Code Number accepted in India.

cotton textile industry which is the single largest industry in terms of employment is also considered for the estimation of the parameters.

Scale and Output Elasticities

We proceed on the assumption that within any particular industry there is a well-defined relationship between outputs (q) and inputs (x) : $q = f(x)$. This relationship characterises "efficient" production, i.e. 'q' is the maximum attainable output for a given 'x'. Of course, we have to make explicit assumptions about the definitions of q and x and the general form of f (x). We define value added (v) as our measure of output and total manhours in production workers equivalent hours (L) and number of non-production workers (NW) as our measure of labour input. Capital (K) is defined in terms of book value of fixed assets and is considered as another input.

For purposes of parameters estimation (and derived productivity estimation) we have used the Cobb-Douglas production of the following form:

$$\log v = \log A + a_1 \log L + a_2 \log NW + a_3 \log K + \text{time period dummy variables.} \quad \ldots (1)$$

Here L refers to total manhours of production workers, NW, to number of non-production workers and K to the book value of fixed capital assets.

Output elasticities (a_i) provide us with a normalised measure of the "importance" of a particular input. The constant ($a_1 + a_2$) measures the elasticity of response of output to labour input and a_3 that of capital input. The sum of the coefficients indicates the extent of economies or diseconomies of scale. If $\Sigma a_i > 1$, then a doubling of capital and labour inputs will give rise to more than two fold increase of output. If $\Sigma a_i < 1$, then a doubling of both inputs will cause output to expand less than two-fold. When the coefficients sum to unity, we have a case of constant returns.

Table 1 gives the scale economies and output elasticities of the industry groups under study. All the industries show a high order of economies of scale. It is highest in the sugar industry and lowest in the food industry. Probably a high scale economies is to be expected in view of the fact that all the factories included are relatively large enterprises. The average size of the firms ranges from 50 in the food industry to about 1000 in the textile and tobacco groups.

Table 1 : Estimated Scale and Output Elasticities by Major Industrial Groups

Industry	$L\ a_1$	$NW\ a_2$	$K\ a_3$	$\sum_i a_i$ *(Scale)*
All manufacturing	0.981 (0.132)	0.073 (0.105)	0.098 (0.057)	1.152
All Food (200)	0.757 (0.055)	0.240 (0.045)	0,102 (.038)	1.099
Grain mills (205)	1.010 (0.118)	0.368 (.096)	0.012 (0.060)	1.390
Sugar and gur (207)	0.972 (0.113)	0.189 (0.07)	0.320 (0.09)	1.481
Miscellaneous Food preparations (209)	0.634 (0.060)	0.189 (0.070)	0.395 (0.039)	1.218
Tobacco (220)	0.821 (0.056)	0.175 (0.065)	0.353 (0.028)	1.349
Textiles (231)	0 908 (0.061)	0.190 (0.143)	0.170 (0.037)	1.268
Cotton textiles (2311)	1.032 (0.138)	—0.025 (0.09)	0.210 (0.109)	1.217

Note : —Figures in the brackets are standard errors of the coefficients

The coefficient of the elasticity of response of output to the labour of production workers is high in most of the industries. It is very high in the cotton textiles (2311) and low in miscellaneous food preparations (209). In the latter a one per cent increase in production labour, with the amount of capital held constant, will add 0.6 per cent increase in output. The capital coefficient is relatively high in the miscellaneous food and the tobacco industry. Contrary to the widespread belief, the non-production workers who constitute the administrative cadre are also productive in many of the industries. The elasticity of response to output of capital is very low in the grain mills and also in the Indian manufacturing as a whole. This may be because of the high level of excess capacity existing in several sectors, particularly, in the basic industries. Probably the capital variable has to be corrected for capacity utilisation to obtain better estimates of the coefficients

Productivity Trends

As the change in the natural log of some variable is the same thing as the percentage change of the variable, the Cobb-Douglas equation given above may be rewritten as :

$$\dot{V}/V = \dot{A}/A + a_1 (\dot{L}/L) + a_2 \frac{(\dot{NW})}{NW} + a_3 (\dot{K}/K) \qquad \ldots\ldots(2)$$

$\dot{V}/V$ is the proportionate change in V over time, i.e. $(dv/dt)/V$ and similarly for the other variables. From this it follows that :

$$\dot{A}/A = \dot{V}/V - a_1 (\dot{L}/L) - a_2 \frac{(\dot{NW})}{NW} - a_3 (\dot{K}/K) \qquad \ldots\ldots(3)$$

The rate of change in A, the efficiency parameter may be considered as an index of productivity change. It is the difference which indicates the mean rate of change in value added after the capital and labour charges are accounted for. We have introduced time dummies in the regressions to capture the yearly variations in the efficiency parameter. Table 2 gives the total productivity indices for the different industry groups.

Table 2 : An Industry-wise Distribution of Productivity Indices

Year	*Total manufacturing*	*Food manufacturing* (202+206 +209)	*Sugar and gur* (207)	*Grain mills* (205)	*Tobacco manufacturing* (220)	*Textiles (all)* (231)	*Textiles Cotton* (2311)
1959	100	100	100	100	100	100	100
1960	108	65	125	72	101	107	109
1961	123	89	98	100	130	125	129
1962	114	88	79	109	116	119	121
1963	114	87	89	118	122	115	123
1964	118	70	127	141	124	104	121
1965	116	69	110	131	124	91	108
1966	118	83	95	108	126	90	116
1967	119	118	—29	70	129	106	N.A.
1968	125	141	75	85	146	102	N.A.

The table shows that during the decade 1959-69, the manufacturing sector in India has registered moderate improvements in productivity. The performance of tobacco industry seems to be by far the best. The trend in the food industry as a whole does not seem to be encouraging. Sugar and gur seem to have had a bad performance. They were apparently hard hit by the industrial recession of 1965-1967. The productivity behaviour of most of the textile groups was also not good. There were great year to year fluctuations. However, the cotton textiles for the eight years for which data are available performed some what well.

It is a well known fact that Maharashtra and West Bengal are the major industrially advanced states in India. *Ceteris Paribus,* their productivity also should be considered high. Introducing state dummies except for Maharashtra in the regressions for all manufacturing, we tried to examine the position of the other states. It is seen in Table 3 that the inference in regard to Maharashtra is empirically valid, while wrong in the case of West Bengal.

Table 3 : A State Level Comparison of Industrial Productivity

Name of State	*% level in relation to Maharashtra*	*Name of State*	% level in relation to Maharashtra
Andhra Pradesh	25	Mysore (Karnataka)	70
Bihar	89	Orissa	61
Gujarat	93	Punjab and Haryana	32
Kerala	28	Rajasthan	44
Madhya Pradesh	15	Uttar Pradesh	52
Tamil Nadu	70	West Bengal	79
Maharashtra	100		

It lags behind Gujarat and even Bihar in terms of total productivity. A close look at the level of technology and performance of the large scale industries in Madhya Pradesh, Andhra Pradesh and Kerala may be necessary if the goal of reduction in regional inequalities were to be taken seriously by the planners of India. Punjab and Haryana which are hailed as the home of agricultural productivity also seem to occupy a lower place in the productivity ladder. Probably, a more reasonable thing to do is to compare the productivity trends in the food manufacturing industry of the green revolution areas with the other parts of the country. This is attempted in Table 4.

Table 4 shows the productivity behaviour of the food manufacturing industry by region. The table shows the excellent performance of the Northern region comprising Uttar Pradesh, Punjab (including Haryana) and Rajasthan. The productivity performance of the Southern region seems to be the worst.

Table 4 : Regional Productivity Trends of Food Industry

Year	*South*	*North*	*East*	*West*
1959	100	100	100	100
1960	77	116	21	104
1961	95	135	80	108
1962	89	145	74	100
1963	94	140	83	113
1964	99	153	90	103
1965	85	154	73	97
1966	84	150	76	73
1967	47	91	75	79
1968	76	155	96	80

Note : South = Kerala + Tamil Nadu + Karnataka + Andhra Pradesh
North = Punjab, Haryana, Rajasthan and Uttar Pradesh
East = Orissa, Bihar and West Bengal
West = Maharshtra, Gujarat and Madhya Pradesh

In sum, we find high scale elasticities in the agroprocessing industries and in the manufacturing sector as a whole. The elasticity of response of output to labour input is significant in most of the industries. The manufacturing sector as a whole shows a somewhat respectable productivity trend.

REFERENCES

1. Annual Survey of Industries (1959-1968) Census Sector, Central Statistical Organisation, Government of India, New Delhi.

2. Bhatia, R.J. "The Production Function for Indian Manufacturers, 1948", *Journal of Bombay University*, Bombay, 1954.

3. Dutt M.M. "The Production Function for Indian Manufacturing", *Sankhya*, Vol. 15, Part IV, 1955.

4. Griliches Z and Ringstad V. Economies of Scale and the Form of the Production Function (North Holland Publishing Co, 1971).

5. Murti V.N. and Sastry V.K. "Production Function for Indian Industry" *Econometrica*, Vol. 25, 1957.

Productivity Trends in Large Scale Manufacturing Industry : A Comparative Study

I.N. Mukherjee

This paper attempts to make a comparative study of the productivity trends in the large scale manufacturing sector of Bihar relative to the productivity trends at the All-India level. The basic data for the study is obtained from the Census of Manufacturing Industries (CMI) for the period 1950-58 and from the census sector of the Annual Survey of Industries (ASI) for the period 1959-67. For the year 1967 the data has been obtained from the provisional summary results of the ASI.

Coverage

The CMI covers all factories registered under the Indian Factory Act, 1948, employing 20 or more workers, using power. The census sector of the ASI covers only those factories which employ 50 or more workers if using power, or 100 or more workers if not using power. The CMI covered 29 industrial groups while the ASI covers as many as 63 industrial groups. Thus, the ASI lifts the coverage of industries to the larger sized units, but at the same time extends its coverage over a wider range of industries.

Limitations

Owing to a change in the classification of industries from CMI to ASI described above, some problems are thereby encountered in measuring productivity trends over the entire period, namely, 1950-67. Another problem relates to changes in the geographic coverage of industries during the fifties.[1] The CMI/ASI data are subject to the further limitation that these relate only to those units submitting returns. However,

1. The change in geographic coverage relates to the inclusion of Saurashtra after 1950, of Andhra Pradesh after 1952, and Mysore after 1953 (See Sinha J.N. and Sawhney P.K., *Wages and Productivity in Selected Indian Industries*, Vikas Publishing House, Delhi. 1970, p. 22).

since the degree of non-response varies from year to year within fairly narrow limits, the productivity ratios are not likely to be affected significantly. The addition of new states in some years and the exclusion of units not submitting returns is not likely to influence the all-India/state average to any considerable extent as they account for only a small proportion of the all-India/state value added and employment. In all the limitations discussed above, one might also bear in mind that these are likely to change both the numerator and the denominator of the productivity ratios in the same direction and hence, to some extent, would cancel out the errors.[2] In view of these considerations, it has been thought desirable to examine productivity trends covering three time periods, namely (i) 1950-67, (ii) 1950-58, (the period covered under the CMI classification), and (iii) 1959-67 (the period covered under the ASI classification). In this way the study would be made to cover not only the entire 18 years period, but also it would be related to two equal sub-periods under the CMI and ASI classifications independently

Indices of Productivity

In precise terms, productivity measures the output per unit of input. Theoretically, there are as many indices of productivity as there are inputs. For our study the measurement of productivity will be, however, confined to four indices of productivity, namely, (i) labour, (ii) capital, (iii) raw materials and fuel[3] and (iv) the index of total factor productivity. Since both labour and capital contribute to output, labour and capital productivities are only indices of partial productivity. Raw materials and fuel input productivity shows the relation between gross and net output and, hence, has a bearing on the surplus that is available for distribution between labour and capital. The total factor productivity index takes account of both labour and capital as inputs.

Labour Productivity

Labour Productivity is obtained by dividing the gross value added by the average daily employment. The average daily employment is obtained

2. The limitations of a study of productivity trends covering the periods under CMI and ASI have been discussed in Sinha and Sawhney, 1970, pp. 22-33).
3. Here fuel productivity includes fuel, electricity and lubricants.

by taking the total attendance of persons in all the shifts on all working days and dividing it by the number of days worked. Gross value added is obtained by subtracting raw material inputs and fuel, electricity and lubricants consumed (but *not* depreciation) from the ex-factory value of output. The cost of services rendered for other firms is not deducted as this forms but a small part of the ex-factory value of output.[4] The justification for not deducting the cost of depreciation from the ex-factory value of output is that under Indian conditions depreciation is calculated at rates allowed by the income tax authorities for assessing taxable income based on certain arbitrary accounting procedures and not on economic criteria,[5]

Being a time series study, the next problem is to obtain the series of gross value added at constant prices so as to correct for changes in the price of gross value added over time. The method adopted was to deflate the ex-factory value of output by the index number of wholesale prices of manufactures, since the bulk of the ex-factory value of output consists of products and by-products of manufactured goods. Next, the value of raw materials inputs and the value of fuel, electricity and lubricants consumed was deflated by the wholesale price index of industrial raw materials and the wholesale price index of fuel, power, light and lubricants respectively. In order to obtain the gross value added figure at constant prices, the deflated values of raw materials and fuel, electricity and lubricants inputs were added and deducted from the deflated values of the ex-factory value of output. The wholesale price index series were obtained from the official publication, "Index Number of Wholesale Prices in India (Revised series) issued by the office of the Economic Adviser to the Government of India, with 1952-53 as the base year. For obtaining the wholesale price index for the relevant inputs and outputs with 1959 as the base year, the wholesale price index with 1952-53 as base for each year since 1959 was divided by the wholesale price index of 1959 such that 1959=100. Since no separate index of wholesale prices could be available at the state level, the price indexes used were the same as that used at the all-India level

4. The data available for ASI 1956 indicates that work done for other concerns accounted for only 0.79 and 1.39 percent of the total inputs in Bihar and all-India respectively.

5. The justification for taking account of gross value added as against net value added in productivity studies has been dealt with by Rosen George in *Industrial Change in India*, Glencoe, Illisoic. Free Press. 1958, p. 55.

assuming no significant inter-regional variation in prices Having obtained the labour productivity at constant prices, indexes of labour productivity have been constructed with 1950 and 1959 as the base years. In columns 2 and 3 of Table 1, the indexes of labour productivity at both the state and all-India levels has been presented at constant prices.

It can be seen from the table that over the period 1950-67 the labour productivity index of Bihar was slightly more than double, while at the all-India level the increase was more than double. A significant increase in labour productivity had occurred both at the state and all-India levels at an annual compound rate of 4.06 and 5.10 per cent respectively. In 1951 the index of labour productivity had registered a sharp increase at both the state and all-India levels presumably owing to the impetus provided by the Korean boom. It was not until 1956 in Bihar, and more permanently, since 1961 at both the state and all-India levels that the peak attained in 1951 was surpassed. During the period 1950-58 a significant increase in labour productivity can be observed in case of Bihar, while no significant trend can be observed at the all-India level. During the period 1959-67, however, a significant increase in labour productivity can be observed at both the state and all-India levels, the rate of increase being greater in the latter case.

In order to comprehend the causal factors behind the growth in labour productivity, it may be interesting to examine how far this is related to an increase in capital intensity. The capital intensity may be measured by the value of fixed capital per employee at constant prices. Having accepted the base year value of the stock of fixed capital from the CMI and ASI data, the increments in fixed capital from 1949 were obtained. These increments in fixed capital were deflated by the wholesale price index of machinery since plant and equipments account for the bulk of fixed capital. The wholesale price index of machinery was obtained as before. The deflated values of the increments in fixed capital were added cumulatively to the fixed capital of 1949 to obtain, for each year, the value of fixed capital at constant prices. Having obtained the value of fixed capital at constant prices, for each year, this was divided by the average daily employment to obtain the value of fixed capital per employee at constant prices. In columns 4 and 5 of table 1 the indexes of fixed capital per employee at constant prices have been presented for Bihar and all-India with 1950 as the base year.

Table 1 : Indexes of Partial Productivities and Capital Intensity in the Large Scale Manufacturing Sector of Bihar and All-India at Constant Prices 1950=100; 1959=100 (CMI and ASI Census Sector)

Year	LP_B	LP_I	FCE_B	FCE_I	CP_B	CP_I	$RMFP_B$	$RMFP_I$
1	2	3	4	5	6	7	8	9
1950	100.00	100.0	100.0	100.00	100.0	100 0	100.0	100.0
1951	141.3	156.3	109.6	107.2	112.9	145.6	111.2	93.8
1952	98.6	98.6	157.7	116.0	62.6	68.1	83.2	79.2
1953	119.3	119.3	167.1	126.5	71.4	81.3	97.2	92.4
1954	117.5	117.5	172.1	131.0	68.1	72.8	88.0	85.3
1955	118.9	118.9	195.0	141.0	60.8	66.6	84.0	82.1
1956	142.2	142.3	218.0	153.5	65.3	74.0	94.8	89.5
1957	137.1	115.3	277.2	177.0	49.4	64.8	97.7	88.5
1958	136.8	119.1	411.5	211.9	33.3	56.0	92.2	88.5
1959	153.2 (100.0)	130.7 (100.0)	384.5	231.6	39.8 (100.0)	90 2 (100.0)	91.9 (100.0)	94.9 (100.0)
1960	155 0 (101.0)	144.2 (110.6)	406.0	256.8	38.2 (96.0)	83.7 (92.8)	91.7 (99.7)	98.3 (103.6)
1961	155.4 (101.4)	153.6 (117.5)	392.0	276.5	39.7 (99.8)	77.8 (86.2)	84.1 (91.5)	98.7 (103.9)
1962	152.6 (99.5)	150.0 (114.9)	395.5	387.0	38.6 (97.0)	47.7 (52.8)	81.0 (88.0)	93.8 (98.8)
1963	147.3 (96.2)	161.6 (123.6)	402.0	431.0	35.8 (90.0)	44.8 (49.7)	85.6 (93.1)	94.2 (99.2)
1964	177.3 (115.7)	186.6 (142.7)	428.0	515.0	41.5 (104.3)	41.7 (46.3)	92.5 (100.5)	102.9 (108.4)
1965	194.6 (127.0)	202.0 (154.8)	596.5	584.5	32.7 (82.3)	46.3 (51.3)	96.8 (105.2)	108.5 (114.3)

1	2	3	4	5	6	7	8	9
1966	215.2 (140.3)	223.2 (170.8)	611.0	679.0	29.1 (73.2)	34.9 (38.7)	106.1 (115.3)	117.9 (124.2)
1967	206.4 (134.8)	225.4 (172.5)	722.0	742.6	28.6 (71.8)	32.4 (36.1)	103.6 (112.6)	116.2 (122.4)
Compound Annual Growth Rate (%)								
1950-67	4.06** (.89)	5.10** (.73)			−7.27** (.84)	−6.18** (.68)	0.00 (.00)	1.45** (.51)
1950-58	3.20* (.38)	0.86 (.03)			−10.93** (.78)	−7.66* (.59)	−099 (.09)	−0.89 (.12)
1959-67	5.24** (.72)	8.07** (.94)			3.28* (.44)	−10.81** (.86)	2.22* (.44)	2.76** (.71)

Note : (i) LP_B and LP_I are indexes of labour productivity in Bihar and all-India respectively.

(ii) CP_B and CP_I are indexes of capital productivity in Bihar and all-India respectively.

(iii) FCE_B and FCE_I are capital intensity (measured by the value of fixed capital per employee) in Bihar and all-India respectively.

(iv) $RMFP_B$ and $RMFP_I$ are the combined raw materials and fuel, electricity and buricants productivity in Bihar and all-India respectively.

(v) The compound annual percentage growth rate is measured by filling a semi-logarithmic function of the form $\text{Log } Y = a + bt$ where y is the variable, whose growth rate is being measured and the variable. with respect to time.

Figures in brackets below the estimated growth rates indicate co-efficient of determination (R^2)

(vi) **indicates significance at 1% probability level

*indicates significance at 5% probability level.

Having obtained the indexes of fixed capital per employee, the regression of labour productivity on fixed capital per employee is obtained both in cese of Bihar and all-India. The form of equation used for deriving the estimates are as follows :

$$LP_t = a_o + b_o \quad FCE_t — 2 \ldots (i)$$

$$LP_t = a_o + b_o \quad FCE_t — 1 \ldots (ii)$$

where LP_t is Labour Productivity in time t, and FCE is Fixed Capital per Employee at Constant Prices. Since the effect of capital intensity on labour productivity can be expected to be felt after a time lag, the variables relating capital intensity have been lagged initially for two years and subsequently by one year. The results of the regression estimates have been presented in table 2. The regression estimates indicate a highly significant relationship between labour productivity and capital intensity over the period 1950-67 at both the state and all-India levels given a time lag of two years between capital intensity and labour productivity. When the time lag in capital intensity is reduced to one year only, a highly significant relationship between these two variables can still be noticed over the period 1950-67. However, while the relationship improves further at the state level, it diminishes a little at the all-India level, pointing to a lower gestation lag between investment and output at the state level.

Table 2

The Regression of Labour Productivity on Capital Intensity in the Large Scale Manufacturing Sector of Bihar and All-India, 1950-67 (CMI and ASI Census Sector)

	a_o	b_o	R^2	*t-value*	*Time lag*
Bihar	0.3338	0.2538**	0.75	6.546	t-2
All-India	0.8836	0.2520**	0.95	17.261	t-2
Bihar	0.3216	0.2433**	0.82	7.961	t-1
All-India	0.9732	0.1968**	0.87	10.079	t-1

Note : (i) Capital intensity is expressed as the value of fixed capital per employee at constant prices.

(ii) R^2 is the co-efficient of determination.

(iii) This indicates the time lag in years between capital intensity and labour productivity.

(iv) ** indicates significance at 1% probability level.

Capital Productivity

This is obtained by dividing gross value added by fixed capital input, both connected for price changes.[6] The deflated gross value added and value of fixed capital have been obtained earlier. In this case an additional price index of machinery has been constructed with 1959 as the base year.[7] The increments in fixed capital have been obtained since 1959 and these have been deflated by the price index of machinery with 1959 as the base-year. The deflated values have been added cumulatively to the fixed capital of 1959 to obtain value of fixed capital at constant prices.

Columns 6 and 7 of table 1, present the indexes of capital productivity for both Bihar and all-India. Unlike in Labour Productivity, here the trend is just the reverse. Over the period 1950-67 the capital productivity index at the state and all-India levels declined by as much as 71 per cent and 67 per cent respectively. The index also showed a significant decline during both the sub-periods, namely 1950-58 and 1959-67. Over the period 1950-67, the rate of decline at the state level was somewhat greater than the all-India level. This is accounted for by a steeper rate of decline during the fifties. During the sixties the rate of decline in capital productivity was, in fact, lower at the state level as compared to the all-India level.

Raw Materials and Fuel Input Productivity

The combined raw materials and fuel input productivity has been obtained by dividing the gross ex-factory value of output by the combined raw materials and fuel, electricity and lubricants inputs both corrected for price changes. The deflated values of these two variables had been obtained earlier while estimating the gross value added at constant prices. Now looking at the index of combind raw materials and fuel input productivity, we can notice in columns 8 & 9 of table 1 that over the period 1950-67, while no trend emerged at the state level, a significant

6. Working capital has been excluded since under inflationary conditions inventory and cash holding are more often determined by supply and market expectation than by purely technological pipeline requirement, (See Rosen 1958, P. 56).

7. This is obtained by dividing the wholesale price index of machinery with 1952-59=100 for each year since 1959 by the price index in 1959 such that 1959=100

Table 3 : Relative Partial Productivity Ratios and Relative Capital Intensity in the Large-Scale Manufacturing Sector of Bihar (CMI and ASI Census Sector)

Year	LP_B/LP_I	FCE_B/FCE_I	CPB/CP_I	$RMFP_B/RMFP_I$
1	2	3	4	5
1950	1.353	1.725	0.836	1.130
1951	1.070	1.767	0.648	1.340
1952	1.690	2.350	0.769	1.187
1953	1.571	2.287	0.735	1.189
1954	1.663	2.270	0.783	1.167
1955	1.712	2.394	0.764	1.156
1956	1.609	2.484	0.737	1.205
1957	1.690	2.708	0.637	1.247
1958	1.555	3.360	0,498	1.173
1959	1.586	2.873	0.369	1.095
1960	1.217	2.731	0,382	1.054
1961	1.369	2.450	0.427	0.964
1962	1.377	1.765	0.677	0.976
1963	1.234	1.650	0.669	1.027
1964	1.285	1.435	0.833	1.016
1965	1.303	1.766	0.590	1.007
1966	1.305	1.548	0.698	1,017
1967	1.239	1.675	0.738	1.008
Compound Annual Growth Rate (%)				
1950-58	3.15 (.31)	7.05** (.65)	—3.55* (.40)	—0.06 (.00)
1959-67	—2.62* (.68)	—7.56** (.70)	9.24* (.54)	—0.51 (.14)

Notes : (i) LP_B/LP_I is the ratio of labour productivity in Bihar with that of all-India.

(ii) FCE_B/FCE_I is the ratio of capital intensity (fixed capital per employee) in Bihar with that of all-India.

(iii) CP_B/CP_T is the ratio of capital productivity in Bihar with that of all India.

(iv) $RMFP_B/RMFP_I$ is the ratio of combined raw materials and fuel electricity and lubricants productivity in Bihar with that of all-India.

(v) Compound annual percentage growth rate is obtained as in Table 1. Figures in brackets below growth rates indicate Coefficient of determination (R^2)

(vi) **Indicates significance at 1% probability level.
*Indicates significance at 5% probability level.

increse in the index could be noticed at the all-India level. An observation of the ratios indicate that the fifties was characterised by declining trends and the sixties by increasing trends, at both the state and all-India levels. The increase in the productivity index during the sixties was higher at the all-India level which more than offset the decline during the fifties. Hence over the period 1950-67 a significant improvement in the index can be observed at the all-India level while no trend can be observed at the state level.

Relative Partial Productivity Ratios

Having examined the trend in the indexes of partial productivity, we may now examine Bihar's relative partial productivity ratios. This is obtained by dividing Bihar's partial productivity ratio with that of all-India partial productivity ratio both at constant prices. Bihar's relative partial productivity ratios have been presented in table 3. Also presented in the table is Bihar's relative capital intensity which is obtained by dividing Bihar's capital intensity (as measured by the fixed capital per employee) by the all-India capital intensity at constant prices. In case where Bihar's partial productivity ratio is greater than all-India's, the relative partial productivity will have a ratio greater than I and, conversely, it will have a ratio less than I where Bihar's partial productivity ratio is less than all-India's. It can be noticed from the table that Bihar's labour productivity has been consistently higher than the all-India level. This can be traced to a higher level of capital intensity in Bihar as compared to that of all-India. Moreover the variation in Bihar's relative labour productivity has been in the same direction as the variation in its relative capital intensity. During the fifties Bihar's relative capital intensity increased significantly while Bihar's relative labour productity also indicated positive (though not significant) growth rate. During the sixties both Bihar's relative capital intensity and relative labour productivity deciined significantly. Unlike labour productivity, Bihar's capital productivity can be seen to be considerably lower than the all-India level. During the fifties there took place a significant decline in Bihar's relative capital intensity. However owing to a milder decline in the index of Bihar's capital productivity during the sixties, its relative capital productivity has improved slgnificantly during this period. Also to be noticed during the sixties is a significant decline in Bihar's relative capital intensity.

Now looking at Bihar's relative combined raw materials and fuel input productivity, It is clear that except for two years (1961 and 1962) Bihar's relative productivity has been consistently higher than the all-India level. Over the period 1950-67, however, Bihar's relative advantage in respect of this productivity appears to have diminished in view of a significant improvement in this index at the all-India level.

Taking a more disaggregated picture of raw materials on the one hand and fuel, electricity and lubricants on the other, it will be seen that Bihar's advantage stems primarily from its superiority in raw materials productivity. This can be observed from the percentage share of raw materials and fuel electricity and lubricants in the ex-factory value of output. In table 4 the average percentage shares of these two categories

Table 4

The Average Percentage Share of Raw Materials and Fuel, Electricity and Lubricants in the Ex-Factory Value of Output in Bihar and All-India (Average : 1950-58 and 1959-67) (CMI/ASI)

	RM_B	FEL_B	Total	RM_I	FEL_I	Total
	1	2	3=(1+2)	4	5	(6)=(4+5)
Average 1950-58	44.74	8.23	52.97	58.63	3.76	62.39
Average 1959-67	45.50	8.41	53.91	50.24	4.86	55.10

Notes : RM_B and RM_I are raw material inputs in Bihar and all-India respectively. FEL_B and FEL_I are fuel, electricity and lubricants inputs in Bihar and all-India respectively.

of inputs in the ex-factory value of Bihar and India have been presented over the periods 1950-58 and 1959-67. Bihar's advantage in respect of raw materials productivity can be well understood given the superior advantage which the state enjoys in respect of basic raw materials. This advantage is, however, to some extent offset by its lower fuel input productivity. Moreover, while over the period considerable improvement in raw materials productivity has occurred at the all-India level, no such trend is to be noticed in case of Bihar.

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Total Factor Productivity Index

Index of labour and capital productivity, however, reflect only partial indices of productivity. Since both labour and capital jointly contribute to output, we must now construct a total factor productivity index which will include both labour and capital as inputs. For our study the construction of a total productivity index is based on the method adopted by J.W. Kendrick. [9] According to this method the total factor productivity index is a measure of the ratio between output and the sum of combined inputs of labour and capital, the inputs being weighted by their base year remuneration, and all inputs and outputs being measured in real terms. Algebraically this may be expressed as follows :

$$\frac{V_t}{W_o L_t + R_o C_t}$$

Where Vt=Gross Value Added in Year t; W_o =Base Year wage Rate,

R_o =Base Year Return on Capital, and L & C=Labour and Capital inputs in Year t.

W is obtained by dividing the total salaries, wages and benefits by the average number of persons employed. R_o is obtained by subtracting salaries, wages and benefits from the gross value added and dividing the result by the value of fixed capital. Depreciation on capital has not been deducted because of the arbitrariness with which these allowances are provided for income tax purposes. The year 1952 was treated as the base year for estimating the wage rate (W_o) and the return on capital (R_o). As such the total productivity index in 1952 would equal 100. This base is, however, subsequently shifted to 1950=100[10] so that this series could be compared with the other partial productivity indexes for which 1950 has been treated as the base year. In order to obtain a total productivity index with 1959 as the base year, the wage rate (W_o) and return on capital (R_o) was calculated for the year 1959. The outputs and inputs were deflated from 1960 with the reconstructed wholesale price indexes in which 1959 was made the base year.

9. J. W. Kendricks, *Productivity Trends in the United States*, Princeton, Princetion University Press, 1961.

10. This is done by dividing the total productivity index of each year with base 1952=100 by the total productivity index of 1950 such that 1950=100.

Table 5

Indexes of Total Productivity in Bihar and All-India, and Bihar's Relative Total Productivity Index : 1950=100; 1959=100. (CMI and ASI Census Sector)

Year	TP_B	TP_I	TRP
1	2	3	4 = (2)/(3)
1950	100.0	100.0	100.0
1951	114.9	195.2	75.5
1952	79.0	74.5	106.2
1953	92.5	93.3	99.1
1954	69.3	85.3	81.2
1955	84.3	81.2	103.8
1956	66.3	94.5	70.2
1957	77.6	88.8	88.0
1958	58.6	83.3	70.3
1959	68.8	86.7	79.4
	(100.0)	(100.0)	(1 0.0)
1960	66.9	89.9	74.4
	(91.5)	(108.0)	(87.2)
1961	68.8	91.4	75.3
	(99.1)	(107.1)	(92.6)
1962	61.6	71.2	86.5
	(95.9)	(82.6)	(105.9)
1963	62.9	71.0	88.7
	(89.2)	(82.5)	(108.1)
1964	73.6	71.8	102.5
	(107.6)	(85.9)	(125.4)
1965	62.0	70.5	82.7
	(94.3)	(85.4)	(110.4)
1966	67.3	68.8	97.8
	(104.3)	(85.0)	(122.7)
1967	56.2	64.7	86.8
	(87.8)	(79.5)	(110.4)
Compound Annual Growth Rate (%)			
1950-67	—2.72**	—2.69**	—0.19
	(.59)	(.51)	(0.00)
1950-58	—6.07**	—3.29	—2.87
	(.66)	(.20)	(.23)
1959-67	—0.18	—3.33**	3.28*
	(0 00)	(.62)	(.55)

Notes : (i) TP_B and TP_I are index of labour productivity in Bihar and all-India respectively.

(ii) TRP is the index of Bihar's total relative productivity.

(iii) Compound annual percentage growth rate has been obtained as in Table 1. Figures in brackets below growth rates are co-efficient of determination (R^2)

(iv) ** Indicates significance at 1% probability level.
* Indicates significance at 5% probability level.

The indexes of total factor productivity for Bihar and all-India as well as Bihar's relative total factor productivity index have been presented in Table 5. It can be seen that over the period 1950-67 the index of total factor productivity declined significantly both at the state and all-India levels. The rate of decline was marginally higher at the state level. The decline in total factor productivity index had been in spite of significant increases in labour productivity at both the levels. At the all-India level, there has been a decrease in the total factor productivity index, in spite of a significant improvement in raw materials productivity. The decline in the total factor productivity index at both the state and all-India levels can thus be attributed to the decline in capital productivity and its greater weight in the total factor input mix. During the fifties the total factor productivity index declined significantly at the state level while no significant decline could be noticed at the all-India level. During the sixties, however, while the total factor productivity index declined significantly at the all-India level, no significant decline could be noticed at the state level.

In view of the aforesaid total productivity trends, Bihar's total relative productivity index,[11] indicated negative growth rate over the period 1950-67 as also during 1950-58, although these trends were not statistically significant. During the sixties however, a significant increase in Bihar's total relative productivity index can be noticed.

Conclusions

It has been observed that the index of total factor productivity is considerably influenced by the trend in capital productivity at both the state and all-India levels because of its greater weightage in the total factor input mix. Increasing capital intensity has not been associated with productive use of capital. The consequent decline in capital productivity has led to a decline in the total factor productivity index at both the state and all-India levels.

It can also be seen that Bihar's relative total productivity index is also considerably influenced by its relative capital productivity index. Again Bihar's relative capital productivity index bears a converse relation with

11. This is obtained by dividing the total productivity index of Bihar with that of all-India.

its relative capital intensity. Thus Bihar's relative total productivity index improved during the sixties with a relative decline in its capital intensity. It appears that the process of capital deepening in the large scale manufacturing sector of Bihar had gone too far during the fifties. Thus economic forces during the sixties shifted the system towards relatively less capital intensive methods of production (which was more in keeping with the state's resource endowment situation), with a consequent improvement in its relative position. The capital productivity in Bihar, however, continues to be significantly lower as compared to the all-India level. Thus emphasis on fuller utilization of existing capital assets is called for before further capital deepening is permitted. In the mean time, while planning for new industrial projects, greater encouragement to more labour intensive methods of production appears to be desirable. At the same time improved materials management and better fuel efficiency is called for if Bihar is to retain its advantage in respect of these two combined categories of inputs.

Productivity of Cotton Textile Industry in India

M.G. Jaiswal B.B. Jani

Productivity is broadly used to express the overall efficiency of an industry. According to Balkrishna,[1]

> "the concept of productivity is of considerable importance as productivity is an index of economic welfare. It is even more important than production, because the differences in the economic conditions of advanced and underdeveloped countries are due more to the differences in productivity among them rather than to their volumes of output."

The ratio of an output of the commodity to the input of the factor is the measure of productivity, in relation to that particular factor of production. The choice of the factor depends upon the purpose of the inquiry. It is well known that the production mainly depends upon two factors, viz., capital and labour. The recent trend in the industry is to replace old machines by modern labour-saving automatic machines, i. e., labour is partially replaced by capital. In this case, the output per manhour will definitely increase, but at the cost of more capital.

In fact, the production also depends upon several other factors like management, resources of raw materials etc., but assuming other factors constant, we can detect the industry in which the net output is more for the fixed amount of investment. The Government is interested in more net output for the fixed amount of labour input and management will desire, in addition to the above, a rise in capital productivity also.

Productivity is commonly measured by :

(i) the gross output per worker (i.e. labour productivity in physical terms),

1. Balkrishna *R* : *Measurement of Productivity in Indain Industry,* University of Madras, 1953.

(ii) the value of the gross output per worker (i. e. labour productivity in value terms); and

(iii) value added by manufacturer (VAM) per worker.

For inter-industry comparisions, gross physical output per worker is impracticable due to differences in the units of measurement of physical output.

The value of the gross output per worker, though it provides a common measure for all industries, is misleading as the use of raw materials entering into finished products varies greatly from industry to industry. But for the purpose of intertemporal comparison for an industry, this is as good a measure as physical output per man-day, if corrected for changes in prices, of the finished products.

In all measures given above, the output has been related to physical labour input. There are many other suggested measures of productivity related to specific factors other than human labour. Comparison on the basis of other inputs like capital, power etc. is feasible, but less meaningful.

Cotton textile industry is one of the major industries in our country, employing about 30% of the total productive capital and about 40% of the total industrial labour force covered by the census inquiry.

A quantitative study of the process of this industry makes it an interesting study. The purpose of this paper is to have the general picture regarding the progress of the industry by studying its productivity measures and some other important indices of measurements.

We have used 'Census of Indian Manufacturers' (CIM) and 'Annual Survey of Industries' (ASI) figures from 1949 to 1966, as they provide primary data. The year 1949 has been used as the base year for comparisons, because various indices can be studied by considering this as the base year, and also because of the fact that the consumer price indices given in 'Indian Textile Bulletin' [2] are also based upon 1949 as the base year.

2. Indian Textile Bulletin, Vol. XIII, No. 7, P. 164

We have calculated for various purposes, in this paper :

(1) Price Indices; (2) Indices of output;

(3) Indices of wages and salaries; and (4) Indices of productivity

Basic Variables

The notations used in the paper are :

n_t = Number of persons employed in the year t (in '000)

d_t = Average number of days worked in the year t

p_t = Total productive capital employed during the year t (in Rs. Million)

s_t = Wages and Salaries paid during the year t (in Rs. Million)

q_t^c = Quantity of cotton consumed during the year t (in .000 Kgs. 180 Kgs = 1 Bale).

v_t^c = Value of cotton consumed during the year t (in Rs. Million)

q_t^y = Quantity of cotton yarn consumed during the year t (in Lakh Kgs.).

v_t^y = Value of cotton yarn consumed during the year t (in Rs. Lakh)

q_t^w = Quantity of cloth (woven piece goods) produced during the year t (in lakh metres)

v_t^w = Value of cloth (woven piece goods) produced during the year t (in Rs. lakh)

v_t^i = Value of total input (i. e. materials consumed) during the year t (in Rs. Million)

v_t^o = Value of products and by-products in monetary units during the year t (in Rs. Million)

VAM_t = Value added by manufacturer during year t (in Rs. million)

For clarity, the various definitions are :

(i) *Area and Period Covered :* The coverage of area under this study is the calendar year for this industry as that described by CIM and ASI. The period of this inquiry also refers to the same period as given in the above publications.

(ii) *Average number of days :* This is computed by dividing the total number of days worked in all mills by the total number of cotton textile mills.

(iii) *The average number of persons employed :* This, for each textile mills, is computed by taking the total attendance of the persons in all the shifts, on all the working days and dividing it by the number of days worked.

(iv) *Total man-days :* This is computed by multiplying the average number of days worked by the number of persons employed. (We use total man-days as the diviser to calculate the output per man-day, wages and salaries per man-day etc.)

(v) *Productive Capital employed :* Includes the total fixed capital plus the total working capital invested by the manufacturer :

(vi) *Value of products and by-products :* It represents the value of products and by-products manufactured for sale during the year. The value is ex-factory, i.e. excluding any incidental expenses on sales. Products consumed for further manufacturing in the industry are excluded.

(vii) *Value added by manufacturer (VAM) :* is defined as the total value of products minus the total value of the materials consumed. It represents the increase in the total value of the commodities that underwent the manufacturing process. It represents the net result of manufacturing activities.

Price Indices

(a) Raw Cotton Price Indices : Let p_t^c = Average price (in Rs. million) of raw cotton (in '000 Kgs.) consumed during the year t

$$\therefore \quad p_t^c = v_t^c / q_t^c$$

The indices from the series p_t^c is calculated and denoted by I (R). These are the indices of the Raw Cotton prices. They are given in column 2 of table 1. The highest value of this index is 146 in the year 1951 and the lowest is 92 in 1955. This index, after attaining the peak value in the year 1951, suddenly declines to 127 and 104 in 1952 and 1953 respectively. Then it does not increases much upto 1959, but after 1959, it increases every year. It means that the price level of cotton is increasing since 1960 and onwards.

(b) Cotton Textile Price Indices : Let p_t^y = Average price (in Rs. lakh) of yarn (per lakh Kgs.) produced during the year t.

Then, $$p_t^y = \frac{v_t^y}{q_t^y}$$

and, p_t^w = Average price (in Rs. lakh) of cloth (in lakh metres) produced during the year t

Then, $$p_t^w = \frac{v_t^w}{q_t^w}$$

then the total value of the yarn produced in the base year at current year price level, is $p_t^y = p_t^y \times q_o^y$,

and the total value of the cloth produced in the base year at current year price level is :

$$p_t^w = p_t^w \times q_o^w = p_t^y + p_t^w$$

$\therefore$ Total value of the cotton goods produced in base year at current year price level $= p_t^y + p_t^w$

We have calculated these values for the years 1949 to 1966, and then calculated the indices for the series of these values with 1949 as the base year. We denote these indices by I (T) and call them cotton textile price index. These indices are given in column 3 of table 1.

Table 1: Price Indices

Year	*Raw cotton Price Index I (R)*	*Cotton Textile Price Index I (T)*	*Consumer Price Index I (C)*
(1)	(2)	(3)	(4)
1949	100	100	100
1950	115	110	101
1951	146	138	105
1952	127	113	103
1953	104	104	106
1954	104	105	101
1955	92	102	96
1956	100	108	105
1957	100	105	111
1958	96	109	116
1959	96	110	121
1960	119	130	124
1961	112	136	126
1962	119	140	130
1963	123	154	134
1964	127	161	152
1965	139	170	166
1966	142	179	184

Referring to the cotton textile price index I (T) given in the above table, we note that it decreases upto 1955, and then again increases steadily. The highest index is 179 in 1966, even though the raw cotton price index is not the highest in that year. It reveals the fact that the cost of manufacturing (including wages and salaries, fuel and other inputs) has gone up. This special index is required to be constructed because the value of the output as given in the census data, is the ex-factory net selling value of products and is exclusive of excise duties and other

duties paid. The wholesale price index number for textiles, regularly published is inclusive of excise duties and it is not useful for our purpose and hence this special index is constructed. We shall use this index to deflate the indices of output and certain indices of productivity in order to find out these indices at constant prices.

(c) Consumer Price Indices : These indices are already available from the "Indian Textile Bulletin". We have taken the values of these indices from the year 1949 to 1966. They are given in column 4 of table 1 and represented by I (C).

We observe, that these indices steadily increase from 1957 onwards, reaching its highest value 184 in the year 1966. Thus, the maximum rise in consumer prices is about 84% during the years 1949 to 1966. It has almost a similar trend to that of cotton textile price indices I(T). We shall use these indices to deflate the indices of wages and salaries in order to find them at constant prices.

Indices of Output

(a) Index of Physical Output : In calculating this index, we have considered the woven piece goods as the output and ignored the production of blankets, towels, hosiery and knitted goods etc., as the units of measurement of these goods are not the same, i.e. they are not in terms of metres

Thus from the series q_t^w (i.e. the quantity of the cloth produced during the year t, in lakh metres) we have obtained the index. This is denoted by I(Q) and it is presented in column 2 of table 2.

Here, we find that this index increases steadily from 1950 to 1957, then it is constant with mild fluctuations. The maximum output is 141 in 1961 and is minimum of 91 in 1950.

(b) Index of output (in value terms) ; The index of physical output gives us the idea whether the physical output has increased or not, irrespective of the quality of the cloth. This can be taken care of, if we consider the value of the physical output. Here we consider the products and by-products in value terms, as the total output of this industry.

The index is obtained from the series v_t^o. First, it is calculated at the current prices with 1949 as the base year and then the index at constant prices is obtained by deflating the index by the cotton textile price index I(T). We denote this index by I (V) and is given in column 3 of table 2.

We observe that the highest value of this index is 155 in 1964 and lowest value is 86 in 1950. The trend of this index is more or less the same as that of the previous index I (Q)

(c) *Index of output per unit of Inputs* : Here we calculate the output-input ratio, in order to know the value of the output per unit of input. We have calculated its index also in order to compare this ratio with the base year.

We consider the value of the products and by-products as the total output and cotton, yarn, colours and chemicals, packing materials etc. as the total input.

Table 2 : Indices of Output

Year	*Index of Physical output I (Q) (at current price)*	*Index of output in value terms : I(V) (at constant price)*	*Total output per input used*	
			Series (at current price)	*Index I (R (at current price)*
1949	100	100	1.6051	100
1950	91	86	1.5405	96
1951	105	96	1.5194	95
1952	118	109	1.4451	90
1953	123	113	1.5659	98
1954	129	122	1.5658	98
1955	133	131	1.6461	103
1956	137	134	1.5933	99
1957	138	140	1.4968	93
1958	121	124	1.5266	95
1959	128	136	1.6010	100
1960	131	135	1.7833	111
1961	141	150	1.8008	112
1962	136	152	1.7445	109
1963	132	145	1.7279	108
1964	139	155	1 7284	108
1965	134	151	1.6996	106
1966	130	148	1.7175	107

This ratio is calculated by the formula : v_t^o/v_t^i, and is given in column 4 of table-2 and its index is given in column 5. We denote this index by I(R). The mean of this ratio is 1.6282, indicating that for the total input worth Rs. 100.00, the products and by-products produced are of worth Rs. 163.00. We revert the average of this ratio, to get the share of raw materials in the gross output, and find that it is 0.6141—i. e., the share of raw materials in gross output is 61.41% on an average. This gives an approximate idea regarding the cost of inventory on raw materials, if the textile mill aims to have certain target of production.

Indices of Wages and Salaries

(a) Index of Wages and Salaries per man-day : We obtain the series for wages and salaries per man-day by the formula :

$$\text{Wages and salaries (in Rs.) per man-day} = \frac{S_t}{N_t . D_t}$$

The series and the above index are given in columns 2 and 3 of table 3 respectively.

In order that we can compare this with the real earnings made by the employees, we convert the above series at constant prices by deflating it by the consumer price index number I(C). The deflated series and its index at constant price are given in columns 4 and 5 respectively of table 3. We find that the average value of the wages and salaries per man-day at constant prices is Rs. 4.70 and from the index of wages and salaries per man-day at current prices, we observe that this index is 216 in 1966, thereby showing an increase of 116%, in wages and salaries. But this is not the real rise, as the general price level has also gone up. So we refer to the deflated values of this series and note that the maximum rise is only about 24% in the year 1963, the value of wages in this year being Rs. 5.40. It is surprising to note that this has gone down to Rs. 5.10 in 1966, even though the consumer price index has gone up. However, we can say that wages and salaries have increased on the whole during the last decade.

(b) Index of Wages and Salaries Per Unit of Gross Output : In order to find out the share of labour in gross output, we have calculated the labour-output ratio, where labour as well as the gross output (i.e. products and by-products) are measured in terms of the monetary units

Table 3 : Indices of Wages and Salaries

Year	*Wages and Salaries per man-day*				*Wages and Salaries per unit of Gross Value of output*			
	Series (at current price) Rs. per man-day	*Index (at current price)*	*Deflated Series (at constant price)*	*Index (at constant price)*	*Series (at current price)*	*Index (at current price)*	*Deflated series (at constant price)*	*Index (at constant price)*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1949	4.40	100	4.40	100	0.2596	100	0.2596	100
1950	4.40	100	4.30	99	0.2424	93	0.2639	102
1951	4.60	105	4.30	100	0.1941	75	0.2552	98
1952	4.80	109	4.60	106	0.2256	87	0.2476	95
1953	4.90	111	4.60	105	0.2484	96	0.2437	94
1954	4.80	109	4.70	108	0.2356	91	0.2449	94
1955	4.70	107	4.80	111	0.2327	90	0.2473	95
1956	5.10	116	4.80	110	0.2398	92	0.2466	95
1957	5.20	118	4.60	106	0.2491	96	0.2357	91
1958	5.30	120	4.50	103	0.2485	96	0.2335	90
1959	5.50	125	4.50	103	0.2578	99	0.2344	90
1960	6 10	139	4.90	112	0.2393	92	0.2509	97
1961	6.30	143	5.00	113	0.2309	89	0.2494	96
1962	6.90	157	5.30	121	0.2442	94	0.2629	101
1963	7.30	166	5.40	124	0.2374	91	0.2728	105
1964	7.90	180	5.10	118	0.2403	93	0.2546	98
1965	8.70	198	5.20	119	0.2547	98	0.2608	100
1966	9.50	216	5.10	117	0.2537	98	0.2470	95

It is calculated by using the formula :

$$\text{Wages and Salaries per unit of production} = \frac{S_t}{V_t^o}$$

It is given in column 6 of table 3. From this series, we find that the average value of this ratio is Rs. 0.24, indicating that the industry has to pay Rs. 0.24 towards the wages and salaries for the production of cloth worth Rs. 1.00. We have calculated the index of this ratio at current price (with 1949 = 100), which is given in column 7 of table 3. We see that the share of labour in gross output has uneven fluctuations. We have also calculated the labour output ratio by deflating gross output by the cotton textile price index I(T) and wages and salaries by the consumer price index I(C). This ratio and its index are given in columns 8 and 9 respectively of table 3.

The average of this ratio is 0.238, indicating that this industry has to pay Rs. 0.24 towards wages and salaries for the production of cloth of Rs. 1.00, when we consider both the values at constant prices. In the previous case also, the average is 0.24. So we can say that about 1/4th i.e. 25% amount of the value of the gross output is utilised towards the wages and salaries in this industry.

Referring to the index given in column 9, we see that this index is more or less the same as that at current price. During the years 1949-1966, this is more or less constant except with little fluctuations on either side. So we can say that there may not be a notable technical improvement in the process of production of this industry.

Indices of Productivity

(a) Indices of Labour Productivity : We have already obtained the index of output per unit amount of raw materials (page 582). Labour, an important input of production, can be measured in two units : (i) physical units (i.e. man-days) and (ii) monetary units (i.e. wages and salaries). Both these units are equally important. So we have calulated the following indices of labour productivity :

(i) Index of physical output per man-day;

(ii) Index of value of output per man-day; and

(iii) Index of value of output per unit of wages and salaries paid.

(i) Index of Physical Output Per Man-day : This is the simplest and commonly used index of labour productivity. We have considered woven piece goods as the quantity of gross output, ignoring the production of blankets, towels, hosiery and knitted goods etc., as, the unit of measurement of these goods is not in terms of metres.

First, we determine the series from the formula :

$$\text{Physical output in metres per man-day} = \frac{q^w_t}{N_t . D_t}$$

This series is given in column 2 of table 4 and its index (with 1949=100). in column 3. We shall call this index as the index of labour productivity in physical terms and denote it by I (P).

We find that the mean of this series is 18.18. This means that on an average, about 18 metres of cloth is produced per man-day in this industry. The index increases from 1949 to 1953, then it decreases upto 1966. During 1962-66, there is no substantial decrease in its value. The index has its maximum value 123 in the year 1953, thus having a maximum rise of 23% during 1949-1966. The decreasing value of productivity indicates a caution for the industry, regarding the efficiency of production.

(ii) Index of value of output per man-day : Here we do not consider the quality of cloth and calculate another index of value of output (products and by-products) per man-day, i.e. the index of labour productivity considering the output in value terms.

This is calculated with the help of the formula :

$$\text{Value of output (in Rs.) per man-day} = \frac{v^o_t}{N_t . D_i}$$

First, we have calculated the above series at current prices which is given in column 4 of table 4 and then in order to have real measure of production, we have deflated the series by means of cotton textile price

index I (T). The deflated series and its index are given in columns 5 and 6 of table 4.

The maximum value of the series is 374 for the year 1966, at current price. This means that the cloth worth Rs. 374.00 is produced per man-day in 1966 at current prices.

The deflated series (at constant prices) has its mean = 187.00, which indicates that at constant price, the cloth worth Rs. 187.00 is produced by an average worker per man-day. The deflated index does not increase much upto 1955, then it more or less increases upto 1966. It is 124, the highest in 1966.

The index increases from 94 in 1955 to 117 in 1956, the increase being 23%, the maximum during all the years. So there may be some notable changes in the year 1956. After 1956, the index more or less increases and attains the value 124 in 1966, which is maximum. The productivity increased only by 7% from 1956 to 1966, which is by no standards sign of progress. One can say that most of the mills might be working with the same type of machines, which might have been proved technicaly obsolete with the passage of time.

(*iii*) *Index of Output per unit of Wages and Salaries :* Measuring the labour employed in terms of monetary units, we first calculate the series for output (in value terms) per unit of wages and salaries paid to the employees by the formula :

$$\text{Value of output per unit of wages and salaries} = \frac{v_t^o}{S_t}$$

The series and its index are given in columns 7 and 8 of table 4. A positive change in the value of the above ratio indictaes a technical improvement.

It is observed that the highest value is 134 in 1951 and 115 in 1952 and then it decreases. In the years, 1965-1966, this index is 102. One might conclude that either there is no improvement on the production side, or even if there is any, it is far below the satisfactory level.

Table 4 : Indices of Labour Productivity

Year	Physical output per man-day		Value of output per man-day		Value of output per unit of wages and salaries		
	Series (metres per man-day	Index (at current price)	Series at current price) (Rs. per man-day)	Deflated series (at constant price) (Rs. per man-day)	Index (at constant price)	Series (at current price)	Index
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1949	16.15	100	169	169.0	100	3.8515	100
1950	16.84	104	182	165.4	98	4.1240	107
1951	18.08	112	239	173.1	102	5.1502	134
1952	19.59	121	214	173.9	103	4.4311	115
1953	19.91	123	199	168.6	100	4.0243	105
1954	19.58	121	204	159.3	94	4 2443	110
1955	19.56	121	205	157.6	94	4.2963	112
1956	19.27	119	213	197.2	117	4.1690	108
1957	18.95	117	210	200.0	118	4.0129	104
1958	18.47	114	216	198.1	117	4.0238	105
1959	17.71	110	216	196.3	116	3.8777	101
1960	18.30	113	257	197.6	117	4.1786	109
1961	17.95	111	272	200.0	118	4.3291	112
1962	17.44	108	285	203.5	121	4.0942	106
1963	17.25	107	307	199.3	118	4.2109	109
1964	17.59	109	329	204.3	121	4.1610	108
1965	17.09	106	343	202.0	120	3.9254	102
1966	17.57	109	374	209.0	124	3.9387	102

(*b*) *Index of Capital Productivity :* In order to find out the net output (in value terms) per one rupee of investment in this industry, we have calculated the capital productivity for this industry. The series is obtained from the formula :

$$\text{Capital Productivity} = \frac{(VAM)_t}{p_t}$$

The series and its index are given in columns 2 and 3 of table 5. We find that the series has mean=0.6294, s.d.=0.1063 and range=0.2523. It means that for one rupee of investment in this industry, the value added by manufacturer on an average is about Rs. 0.63 per year, which is better in comparision with this value for other industries.[3] That may be one of the reasons, why there is a maximum proportion of investment (about 30% to 35%) in this industry considering the investments in all the other industries and the industrial sector as a whole in India. From the index of capital productivity given in column 3 of table 5, we can see that the maximum rise in capital productivity is about 55% during 1949-1966.

(*c*) *Value Added By Manufacturer (VAM) Index :* This index is also known as the difference between the gross value of the product and the total value of all other factors entering into the production cycle including capital servicing charges.

This measure would be a preferred measure except for the fact that it is influenced by the price changes and has, therefore, to be deflated by an appropriate index of changes in price. Although it is possible to obtain satisfactory index of the prices of the finished goods, it is not possible to eliminate from the finished goods prices, the influence of the prices of all the raw materials, used in production. No price data are available for the prices of finished goods uninfluenced by the prices of raw materials. It is, therefore, impossible to construct a reliable price index with the available data, to use for computing an index of real net output. For purposes of comparisons, however, the index of textile prices used earlier has been used here also to deflate the value added by manufacturer per man-day.

3 See M. C. Jaiswal 1913, "Capital Productivity, Distribution of Capital and Wage—Capital Ratios in Indian Industries"—Journal of Gujarat Research Society, Vol. 25, P. 117-125.

Table 5 : Capital Productivity and VAM Indices

	Index of Capital Productivity				*VAM Index*	
Year	*VAM per total capital employed =(VAM) / P (in Rs.)*	*Index (at current price)*	*VAM per men-day (in Rs. per man-day) at current price*	*Index (at current price)*	*Deflated series (at constant price*	*Index (at constant price)*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1949	0.7158	100	6.0	100	6.0	100
1950	0.5140	72	5.9	98	5.3	89
1951	0.6192	89	7.7	128	5.5	93
1952	0.4895	68	6.1	102	5.3	90
1953	0.5596	78	6.7	112	6.4	108
1954	0.5853	82	6.8	113	6.4	108
1955	0.6595	92	7.4	125	6.9	116
1956	0.6049	85	7.5	125	6.9	116
1957	0.4678	65	6.5	108	6.1	103
1958	0.4635	65	6.9	115	6.3	106
1959	0.7310	102	7.3	122	6.6	111
1960	0.8603	120	8.9	148	6.8	114
1961	0.8047	112	9.5	158	6.9	116
1962	0.6843	96	9.4	157	6.7	112
1963	0.6551	92	9.7	162	6.2	105
1964	0.6724	94	10.3	172	6.3	107
1965	0.6349	89	10.4	173	6.1	102
1966	0.5958	84	11.3	188	6.3	105

Thus we obtain first the series by the formula :

$$\text{Value added by manufacturer (in Rs. per man-day)} = \frac{(VAM)_t}{Nt_t \cdot D_t}$$

This series and its index are given in columns 4 and 5, respectively, of table 5. Then we deflate this series by means of textile price index I (T) and obtain its index at constant price. The deflated series and its index are given in columns 6 and 7, respectively, of table 5.

We see that the value added by manufacturer (VAM) at current prices increases throughout from 1949 onwards. Its value is maximum in the year 1966 and it is Rs. 11.30 indicating the net gain per worker per day, at current prices. The average of this series is Rs. 8.20. But as these values are at current prices, this average has no meaning. Thus referring to the deflated series given in column 6, we see that the value of the series increases after 1953 and is more or less higher upto 1962. Afterwards, it decreases; the value is maximum in the year 1955 and it is Rs. 6.90 indicating the highest productivity in this year at constant prices. So we can definitely say that during the first and second plan, periods, the productivity has increased, but it has slightly decreased in the third five year plan period. The average value of this series is Rs. 6.20, indicating that the gain in this industry is Rs. 6.20 on an average per man-day. The same fact is reflected in the index of this series.

Conclusions

From the above analysis, the following conclusions can been drawn :

(1) Physical output in quality as well as in value terms has increased more or less, throughout the period 1949-1966.

(2) The share of raw materials in gross output is roughly 61% on an average i.e. an output of Rs. 100.00 requires an input of Rs. 61.00 on an average.

(3) Average value of the wages and salaries per man-day is Rs. 4.70 at constant prices (1949 = 100). Real wages and salaries

have increased upto 1963, but they have decreased from 1964-1966, of course, it is higher than the average value, in the last 3 years also.

(4) The share of labour (i. e. wages and salaries) in gross output is about 24% in this industry on an average—i. e. about 1/4th of the amount of the gross output is utilised towards the wages and salaries.

(5) About 18 to 20 metres of cloth (woven piece goods) is produced per man-day.

(6) The cloth worth Rs. 187.09 (at constant prices with 1949= 100), is produced by an average worker per man-day.

(7) For one rupee of investment in this industry, the value added by manufacturer on an average is about Rs. 0.63 per year, which is better in comparision with other industries. This is the reason why this industry tops among all the other industries in India, from the investment point of view.

(8) Labour productivity in value terms is not very encouraging as it remains more or less constant from 1956 to 1966.

(9) The value added by manufacturer (VAM) per man-day is of Rs. 6.20 on an average (at constant prices with 1949=100)

From all the above conclusions, we may say that though there has been a progress in industry during 1949-1966, it is not that satisfactory and encouraging as it should have been and the use of modern machines and techniques should be applied further for the advancement and also for a hopeful, and promising future of this industry.

Productivity in Rolling Mills

R. Singh **B. Lakshminarayanan**

Production and productivity are terms which are generally confused with one another. However, in industrial parlance, both have quite different meanings. Production relates to a volume, whereas Productivity is an efficiency ratio between output and input. In other words, productivity is the principle of realization of maximum effect with minimum cost. This is sometimes divided into two principles viz., the minimum cost principle and the maximum effect principle. The former assumes a fixed effect which should be achieved with the minimum cost and the latter postulates a fixed cost with which to achieve the maximum effect. These rules regularly govern all types of economic behaviour. In Rolling Mills, effect is the production and cost is the input. The higher the output and lower the inputs, the better is the productivity.

Rolling Mills

To consider the productivity in Rolling Mills, in the light of the above definition, we have to first determine the product or output and also the various productive factors, which can be grouped as the inputs.

Rolling Mills encompass a very wide field, but for the purpose of this article, a normal steel rolling mill producing various merchant sections can be considered. In such a mill the production is measured in tonnes and is dependent on the following inputs or productive factors : a) capital; b) labour; and c) raw-material.

On the management falls the task of utilising the above resources effectively, to achieve a high level of productivity At the same time, it has to be realised that the management can only work within limits provided by the following factors : (i). level of technical know-how; (ii), level of social, political and business organisation.

As regards technical know-how, the rolling mill industry of the world

has made unparalleled progress, more so in the last 8 years, and as far as rolling mills in our country are concerned, it may not be possible, nor is expected of them to come up to the same level of advancement as that of the more developed countries. The second factor concerning social, political and business organisation poses a more serious problem to the management of our rolling mills, as there is very little that they can do themselves about it.

Therefore, the productivity in our rolling mills becomes a function of the aforesaid three factors, viz., capital, labour, and raw-material. In the efficient allocation and utilisation of these three main resources lies the higher productivity of our plants. The rolling mills is basically a plant which can produce a range of elongate products of various cross sections economically, by operating to a predetermined production plan, based on orders placed, which are within the mills' capacity. In any rolling mill, the careful observation and investigation of all the resources being properly utilised is a long and continuous task, and out of money, men and materials, it is indeed difficult to determine which one is the most important criterion of productivity. However, there has to be a common denominator to compare past performances with present, and present performances with planned. This common denominator in a rolling mill, and for that matter in any other plant is in terms of capital.

Capital base is necessary in any business and arrives mainly through profits. The more efficient or productive the mill, the more profits can accrue to the corporation. By reducing manufacturing costs the greater will be amount of return. The quality of the product must, however, remain acceptable to the customer.

Cost of Production

A typical break-up of the operating costs in a rolling mill is shown in Table 1.

The operating costs of any rolling mill is essentially made up of 3 elements, viz., fixed costs, time variable costs and tonnage variable costs. The first of these, viz., the fixed costs are constant and will have to be incurred irrespective of time or tonnage To economise, one must try to reduce the time variable costs and tonnage variable costs. Of

Table 1: Break-up of Operating Costs in a Rolling Mill

	Amount (in Rs.)
Cost of raw-material (inclusive of wastage, excise and other taxes)	1560.00
Consumable Stores	20.00
Rolls	15.00
Wages (Operations & Maintenance)	17.40
Salaries (Administrative)	15.60
Electricity	18.00
Furnace Oil	25.00
Depreciation	35.00
Overheads	34.00
Total ...	Rs.1,740.00

course, there is scope for reducing many other costs, for example, labour costs by productivity bargaining and maintenance costs by planned preventive maintenance. But the two main factors which need the utmost attention are the yield and utilisation. Yield is the percentage of raw material that can be sold as finished product, and utilization is the actual rolling time expressed as a percentage of the total available time. Yield can be increased by reducing the loss due to scrap either in process or due to defective material. Occurrence of cobbles and resultant down-time are the major items as compared to other losses. To reduce the occurrence of cobbles it is necessary that the guides are properly designed and accurately aligned. The mill stoppages should be regularly recorded for each shift in detail along with the reasons for the stoppages. This data can be taken for their remedy. Also, the yield can be improved by obtaining the maximum finished product from each billet, i.e., by minimising the amount of crops. Close observance of tolerance are necessary to improve yield.

Utilization

Utilization can be improved by reducing scheduled and non-scheduled stoppages of the mill. Scheduled stoppages are the stoppages for roll changing and this can be reduced by improving the pass design and the product mix. Non-scheduled stoppages are due to electrical and mechanical faults, roll wear and non-availability of spares. Down-time can be

reduced by improving the roll life by choosing proper roll material and planned regular mechanical and electrical maintenance.

One such example of improved working can be shown in Table 2. With ingot rolling and heavier billets, there was an occurance of split ends which resulted in stick up not only causing considerable roll spoil, but also lower production due to down-time. The installation of rotary shears for the cutting of front and tail end almost eliminated this problem.

Table 2 : Advantage of Installing Rotary Shear in Cropping Split Ends (Working of Average Shift)

SECTION	BEFORE			AFTER		
	Prod. (tons)	Roll Spoils (tons)	Down Time Minutes	Prod. (tons)	Roll Spoils (tons)	Down Time Minutes
10 mm Rd.	45	2.3	85	62	0.4	20
12 mm. Rd.	50	2.0	45	66	0.3	15
16 mm. Rd.	60	1.0	30	68	0.2	05

In addition to the above gains, it follows as a natural corollary that productivity of the unit further increases by way of savings in metal losses in furnace, fuel and gases etc., that would have been used to cut the stick up and roll spoils. By such measures the yield is kept at the maximum of the good material, i.e., that material which will conform to the relevant specification.

We shall now consider the other important factor which contributes greatly to productivity. This is plant or mill utilization. A typical example of the actual utilization of the mill time can be shown as under :

No. of Shifts per month	50	
Total No. of hours 50 x 8	400	hours
Planned roll changing time	40	hours
No. of hours the mill is availablefor rolling	360	hours
Pass changing during shifts	37	hours
Break-down time	30	hours
Utilization of the mill	293	hours
Percentage of utilization	73.25%	

Most plants utilize their capacity in the range of 60 and 65%, which means that there is scope for improvement. The above figure of 73.55% can also be bettered if roll changing is done in the third idle shift. Similarly, a gap of one hour can be given between the shifts for scheduled pass changing. Such a system can increase the percentage utilization from 73.25% to 92.5%.

Fuel Cost

Fuel cost is another factor which affects the productivity of a mill, since it is the largest single item of direct cost. The re-heating furnace should not only be of proper design but should also be operated correctly. The flue gases represent the greatest source of heat loss and due importance should be given to the damper control. A recuperator can be an additional fuel saver. A slight negligence in this respect can make a large difference in the overall consumption of furnace oil.

New Sections

A phenomenon common in the rolling mills is that, invariably, there may be a demand for a new section whose market price is considerably higher. This generally attracts the management and necessary instructions are given to the rolling mill. In such a case the most difficult factors which the rolling mill department has to consider are the yield and production rate, which will be much less than normal in the first few rollings. This disadvantage can be offset if the tonnages involved are fairly high, capable of covering a rolling period of at least 200 hours.

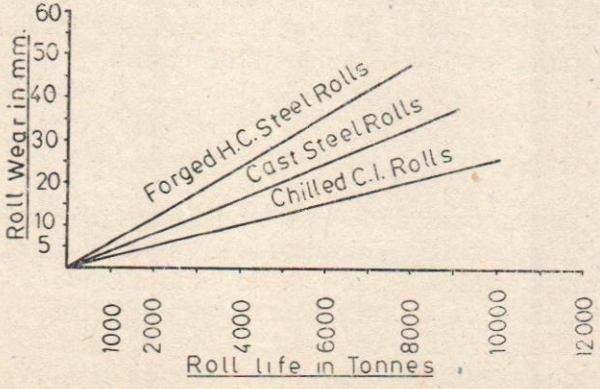
Roll Life

As mentioned above, pass and roll changing are the major factors contributing to mill down time. This time loss is partly inevitable because of change in product or size. Such down time can be minimised only by increased rationalisation of the product mix and sizes. For the remaining portion, the effect can be reduced by scheduling roll and pass changing to occur at natural break points and shift changes. But in many cases, this may not be possible and with greater automation, it will

become very difficult. Hence, it can be concluded that improvement in roll life will substantially reduce the down time and thereby the production cost. Of course, it is to be understood that the additional expenditure incurred for obtaining the improvement in roll life should not offset gains achieved therefrom. However, for high speed wire rod mills with finishing speeds of 60 meters/second, it may only be possible to achieve good results by using tungston carbide rolls.

The roll yield can be substantially increased if the allocation of orders is distributed in such a way that the run of each section is matched with the total yield of the grooves that are in each roll. This, of course, means a great strain on the technology of the roll manufacturers who will have to market such rolls suitable for each succeeding stand in a rolling mill. On the other hand, such mills which exclusively roll a section or two throughout the year, definitely have a better utilization of the rolls and, consequently, better productivity. It is extremely imperative that the rolls are worn out to the minimum diameters possible as the scrap value of a roll is very poor if compared to the cost of a new roll. For instance, a new chilled roll will cost Rs. 10/- per kg., whereas, the rejected roll will only sell as cast iron scrap whose value will be Rs. 0.70 per kg.

Roll life can also be increased by the welding of the grooves with suitable electrodes or metal deposits. However, this process is still new to our country and will take some years more to ascertain its worth.



Typical Graph showing Roll Life

Automation

Productivity can also be increased through automation, whereas, automation just for the sake of it is not very welcome in our country. It has to be understood that in rolling mills automation is imperative for the simple reason that manual handling becomes impossible with increase in weights and higher speeds. It is also inhuman to expose the labour to such hazardous task involving high temperatures. A balance has to be struck between the expenditure incurred on automation and the resulting benefit.

Conclusion

The productivity of the rolling mills in our country on the whole is very low, and we engineers can, indeed, contribute munificiently towards the betterment of national economy. Higher productivity as a goal should be the guiding spirit of engineers working in the rolling mills of our nation.

Productivity and Unit Costs of Indian Education System*

Shri Prakash **

Productivity of an activity or a process is a technical relation between output and resource inputs.[1] It can be defined as output per unit of inputs of resources in real terms. Changes in the productivity of a process measures the technical progress over time. The objective of productivity studies is to determine whether inputs are becoming capable over time of producing more output. It is, therefore, measured between two calender dates. Productivity of an educational process or activity or system can be defined similarly as output of education per unit of resource inputs into the educational process/activity or system.

Study of productivity of an educational system poses difficult problems. The main difficulty is that there is no unique measure of the productivity of education. It is because there is no consensus as to what constitutes educational output. Conceptualisation of educational output is made difficult by the multiplicity of objectives that govern educational decisions and processes.[2] Then, for comparing productivity, at different points of time, it is essential that both the inputs and outputs are measured in terms of constant quality. As the students constitute both inputs and output of education, their quality does not remain constant over time. Knowledge explosion and better facilities raise their quality almost continuously. Another difficulty is that education is a multi-product industry. For example, teaching and research are the

* Results have earlier been reported in author's thesis "Mathematical Base of Educational Structure As a Guide to Manpower Planning with Applications to Indian Data : A Study Suggested by Input Output Analysis' submitted for Ph. D. degree in Economics of Sagar University.

** I am grateful to my Supervisor, Prof. P. N. Mathur, Professor of Economics, Wales University, Aberystwyth, for his valuable suggestions.

1. Salter, W. E. G. : Productivity and Technical Change, Cambridge, 1960, Chapters 1 & 2.
2. For overcoming this difficulty, Rickover suggests that all students of public schools should be administered Federal Examination so that the performance of all institutions can be judged objectively. Quoted by Kershaw : Productivity in American Schools and Colleges in Blaug, M. : Economics of Education, Vol. II, Penguin, P. 307.

two joint products of university education.[3] Besides, personal satisfactions and cultural awareness of the students and such other factors are all a part of the educational output.

Like other goods and services, output of education is defined as value added to student between the time of their entry into the educational system and the time of their graduation where the value added by the educational system is equal to the difference between the value of education produced and its resource cost of production.[4] Value of education is measured by the differential incomes of persons with education of different levels and types. But the measurement of the volume of education by income that is associated with it will be subject to the same defects as are associated with the measures that are based upon prices.[5] The time and services of students, teachers, administrators and other ranks and capital goods such as buildings, equipment, furniture, books and other materials constitute the inputs of education. Earnings foregone provide a measure of the economic value of the input of time and services of students. Other goods and services can be evaluated at their market prices. As in case of other goods and services, the monetary measure can, thus, be used to evaluate both the inputs and output of the educational system.

Pass Ratio As a Measure of Educational Productivity

We have used the number of passes in an examination as a measure of output of an educational process and the number of students enrolled in the first year of the given educational course, with appropriate time lags, as a measure of inputs. The ratio of the two numbers is defined as pass ratio. The output can be converted into money terms by multiplying the number of passes by the price which that grade of education can command in the labour market.[6] But data relating to earnings by education for the entire period covered by the study are not available for India.

3 'Like mutton and wool, they are joint products of the academic sheep.' Carter : Economics of Higher Education, Manchester School of Social and Economic Studies, Vol. XXXIII, No. 1, Jan., 1965 P. 2.

4. Blaug, M: The Productivity of Universities, in Blaug : Op. Cit., P 317.

5. Correa, H. : Economics of Human Resources, North-Holland, P 100.

6. Woodhall and Blaug : Productivity Trends in British University Education, 1938-62, in Rogers, D.C. and Ruhlin, H.S. : Economics and Education, P 128.

Use of the number of students, enrolled for a course, as total resource costs is a gross under-estimation of the value of inputs so far as it neglects the value of labour and capital used to produce a given amount of education. Therefore, this measure of productivity can be considered only as a first approximation. It is, however, capable of shedding light on some important aspects of education. It is commonly believed that an unprecedented explosion of enrolments leads to either of the two results : if standards are maintained, pass ratios would decrease or an unprecedented rise in pass ratios would occur if the standards are allowed to be lowered. It (pass ratio) also provides an indirect estimate of the magnitude of wastage and stagnation. Keeping in view the data difficulty and the fact that, in independent India, enrolments have expanded at phenomenal rates, the above defined measure of pass ratio has been used in the study. The pass ratios of various levels and types of education have been calculated for the years 1952 to 1964. As different courses are of different duration, different time lags have been used to derive the pass ratios of different courses. For example, mean duration of primary education is five years. Therefore, the pass ratio of primary stage in 1955 is derived as a ratio of 1955 passes in primary/junior basic examination and the enrolments in class I in 1951.

The pass ratios of the various grades and types of education are shown in Table 1.

Table 1 : Number of Passes Per Student Enrolled in the First Year of the Course

Year	*Primary*	*Middle*	*High/ Higher Sec.*	*Inter/ Pre-Prof*	*Inter Com.*	*B.A. Pass & Hons.*	*B. Sc. Pass & Hons.*	*B. Com. Pass & Hons.*	*M.A.*	*M. Sc.*	*M.Com.*
1952				.380	.418	.590	.538	.347	.550	.787	.283
1953		.470	.486	.372	.366	.789	.620	.310	.501	.723	.312
1954		.487	.494	.382	.372	.585	.566	.261	.583	.713	.360
1955	.278	.545	.602	.404	.405	.578	.606	.294	.585	.754	.338
1956	.308	.603	.570	.366	.343	.530	.535	.294	.587	.735	.329
1957	.321	.504	.572	.352	.305	.535	.531	.307	.600	.766	.328
1958	.311	.612	.568	.310	.336	.556	.484	.265	.610	.739	.316
1959	.286	.624	.574	.286	.312	.451	.376	.309	.654	.741	.406
1960	.296	.648	.578	.405	.253	.774	.509	.322	.581	.806	.441
1961	.307	.721	.562	.512	.208	.581	.527	.271	.719	.797	.361
1662	.366	.600	.575	.541	.400	.562	.489	.257	.673	.719	.304
1963	.350	.739	.594	.562	.646	.541	.473	.232	.687	.747	.285
1964	.304	.402	.587	.445	.615	.565	.459	.189	.685	.746	.314

The following important features of the pass ratios of various levels and types of education and their fluctuations over time become obvious :

(i) The pass ratios of all grades and types of education fluctuate over the period covered by the study. But the magnitude of the range of fluctuations varies from a low of .088 for primary education to a high of 0.438 for intermediate (commerce) classes.

(ii) Changes in the pass ratios show a rising trend for all grades and types of education except B. Com. for which the trend is a decreasing one.

(iii) Pass ratios for higher stages of school education are greater than those for the lower stages.

(iv) Pass ratios of B.A. are greater than those of B.Sc. whereas the pass ratios of M.Sc. are greater than those of M.A.. But pass ratios of commerce education are smaller than those of arts and science education both at the graduate and the post-graduate stages.

(v) Finally, pass ratios of college education are greater than those of school education.

It may be inferred from the above that as the pressure of numbers is reduced, pass ratios of an educational process tend to increase. But it is possible that the lower pass ratios of the lower stages of school education is due to factors such as the preponderance of students in these stages of education who come from rural and semi-urban areas and low parental income-education-occupation groups as large scale expansion of educational facilities has taken place in rural and semi-urban areas of India. Greater pass ratios of science education at post-graduate stage may be due to not only fewer numbers but also due to better academic records of the students who are admitted into these courses. But greater pass ratios of other levels of university education may be mainly due to fewer numbers. It is certain that the rise in educational productivity in India has been only gradual despite an enormous increase in enrolments. We cannot say anything about the standards on the basis of the data that we have got. So we are not in a position to say something definite about the hypothesis mentioned above. Measurement of qualitative improvement or lowering of educational standards over time is a difficult proposition. At micro-levels, the difficulties might be manageable. But this is not so at the macro-level.

Teacher-Student Ratios As Measure of Educational Productivity

Teacher-Student ratios are also supposed to reflect the productivity of education. But it can, at best, measure the educational output per unit of labour inputs. Though teaching time constitutes the largest share of total resource inputs into the educational processes, yet the share of other inputs is not entirely negligible. Teacher-student ratios, therefore, reflect labour rather than the total resource productivity of education.[7] Besides, it measures the productivity of teaching but it cannot reflect the productivity of teachers, particularly the college and university teachers who contribute to research also.[8] The use of teacher-pupils ratio as a proxy of the productivity of education impliedly assumes that the educational output is measured by the number of students enrolled and that research should be evaluated to the extent to which it contributes to the improvement of teaching.[9] Another point to be noted is that an increase in teacher-student ratio is generally supposed to lead to a decline in the quality of education. There is, however, no single ratio that can be defined as optimum. It should vary according to the level and type of education, subject of instruction, the teacher, method of instruction and such other factors.[10]

In almost all industries, the trend has been to substitute capital for labour all over the world. But in education, capital has not been used to displace labour. On the other hand, both capital investment and manpower per student tend to increase together. However, in a poor developing country like India, paucity of funds may prevent inputs, both human and capital, from growing at a rate higher than the rate of growth of enrolments. Growth of inputs, in fact, may lag behind the growth of enrolments. It is, therefore, believed that teacher-student ratios increase as a result of enormous growth of enrolments. The hypothesis can be tested empirically with the teacher-student ratios over time for various stages of eductaion as in the next table.

7. Blaug : The Productivity of Universities, in Blaug : Op. Cit., P. 314 and Kershaw : Op. Cit., P 306.
8. Blaug : Op. Cit. P 314.
9. Blaug : Op. Cit., P 314
10. Cf. Kershaw: Op, Cit., P 306

Year	Primary	Middle	High/Higher Secondary	University/College
1950-51	34	24	25	16.8
1955-56	33	26	25	18.0
1960-61	36	31	25	17.5
1963-64	37	32	26	17.3

Source : Fact Book of Manpower, Vol. II, I.A.M.R., Delhi, PP 67 and 121

The teacher-student ratios increased only marginally at all levels of education during a period of 14 years from 1951 to 1964. The teacher-student ratio for primary education increased only by 3 from 34 to 37 students per teacher even though the enrolments rose from 19.154 million in 1951 to 44.55 million in 1964, showing a phenomenal rate of growth of 134 per cent. The teacher-pupils ratio for middle education shows the greatest amount of increase. It rose from 24 to 32 students per teacher, an increase of 8 students per teacher. But the increase looks negligible if we consider the fact that the enrolments in middle education increased from 3.12 million in 1951 to 90.42 million in 1964, the rate of growth being 193 per cent. The ratio for high/higher secondary education also rose from 25 in 1951 to 26 in 1964, an increase of merely 1 student per teacher even though the enrolments increased from 1.18 million to 3.93 million, the rate of growth of enrolments being as high as 233 per cent. College and university education recorded the smallest amount of increase of 0.5 students per teacher over a period of 14 years even though the enrolments increased at 249 per cent from 0.4 million in 1951 to 1.38 million in 1964. It will be interesting to compare the Indian teacher-pupils ratio at the third level of education with those of the other countries. We tabulate below the teacher-pupils ratios for university education for some selected countries along with the Indian ratios for the given years :

The teacher-students ratio in the Indian universities and colleges is much less than the ratio of French and Pakistani universities; it is almost equal to the ratio of the Turkish and Burmese universities; it is not too high in

Country :	U.K.	West-Germany	U.S A.	Burma	Turkey	Pakistan	France
Year :	1963	1960	1964	1960	1964	1963	1964
	9	12	13	15	16	25	27
Indian Ratio	16.3	17	17.3	17	17.3	16.3	17.3

Source : Fact Book of Manpower, Vol. II, P. 129

comparison to the ratios obtained in West-Germany and U.S.A., and it is a little less than double the ratio of British universites. It is obvious, that the stability of the teacher-students ratios that has been maintained during a phase of phenomenal expansion of enrolments in India is a creditable achievement. There is no empirical evidence to support the popular belief that teacher-students ratios must have gone up substantially under the impact of the enormous growth of enrolments in independent India. The increase recorded in the teacher-students ratio, in all cases, is almost negligible and therefore, it cannot be considered as an indication of a general lowering of the standards.

Unit Costs and Productivity of Education

Productivity is considered to be the reciprocal of money costs of production. A major defect of monetary measurement is the fluctuations of the prices over time whereas main point of all productivity measures is to determine the changes in the capacity of inputs to produce output in real terms. The difficulty can be overcome by adjusting the values of physical inputs and output in money terms for the changes in prices during the period under consideration. Adjustment of money cost of inputs and output for price changes will make the productivity measure insensitive to anything except the changes in real output per unit of real inputs.[11] But an adjustment through an index number may not be helpful because of the changes in the price structure. Therefore, each item should be adjusted separately for the changes in its price. Unit costs and their reciprocals have also been considered in the study. Study of the unit costs is of great importance from the view point of educational finances also. Importance of such studies is enhanced manifold when education develops at rapid pace.[12]

Unit costs have been worked out at constant 1960-61 prices. Data relating to unit costs have been taken from 'Education in India, Vol. I.' The costs are given at current prices which have been converted to 1960-61 constant prices by making adjustments for changes in the cost of living index. Item-wise adjustments could not be made as such data item-wise are not available for costs. The unit costs are divided into

11. Blaug : Op. Cit., P. 315.
12. Kamat, A.R. : Two Studies in Education, Gokhale Institute of Politics and Economics, Poona, P. 77.

two parts : direct average cost per student per year by levels and types of educational institutions and total average cost per student per year for all levels and types of institutions. Total average cost per student includes both direct and indirect expenses. There are no separate institutions for individual stages of education in India. For example, primary education is imparted in primary schools, middle schools and high/higher secondary schools. Similarly, middle education is provided in middle schools as well as in secondary schools. The same pattern obtains at the university stage also. For example, M.A., M. Sc., M. Com., B.A., B. Sc., and B. Com. courses are conducted both in the universities and colleges; graduate classes are attached to post-graduate colleges and there are very few colleges imparting instructions only in particular type of courses such as arts, science, commerce or law. Therefore, it is not possible to determine unit costs by types and levels of education. Similarly, it is not possible to distribute indirect expenditure by educational standards. Total average cost is, therefore, related to all educatonal activities of an institution. Unit costs and their reciprocals, simple and compound growth rates are shown in Table 2.

Table 2: Unit Costs and their Reciprocals, Simple and Compound Growth Rates

Year	*Universities*	*Colleges Gen Edn.*	*Colleges Technical Edn.*	*High/ Higher Sec.*	*Middle School*	*Primary Schools*	*Pre-Primary School*	*Direct Average Cost*	*Total Average Cost*
1950-51	176	259	873	82	42	22	61	40	50
	.00568	.00386	.00115	.01220	.02381	.04545	.01639	.02500	.02000
1955-56	198	273	914	98	49	29	67	52	68
	.00505	.00366	.00109	.01020	.02041	.03448	.01493	.01923	.01471
1960-61	183	286	772	87	38	26	46	51	68
	.00546	.00350	.00129	.00115	.02632	.03846	.02174	.01961	.01471
1963-64	213	278	761	88	36	26	44	52	67
	.00469	.00360	.00131	.01136	.02778	.03846	.02273	.01923	.01493
				Compound Growth Rates					
1955-56	2.3	0.9	5.0	3.5	—3.1	5.7	1.9	6.4	6.4
1960-61	0.3	0.4	—1.2	0.6	—2.9	1.6	—2.9	2.5	3.1
1963-64	1.5	0.5	—2.9	0.5	—1.2	1.3	—2.6	1.9	2.3
				Simple Growth Rates					
	21.02	7.34	—12.83	7.32	—14.29	18.18	—27.87	30.0	34.0

A perusal of the unit costs of different institutions reveals the following features :

(i) Unit cost per student per year increases from primary to middle and from middle to high/higher secondary schools. But the cost per student in pre-primary schools is much greater than that for primary and middle schools. It might be due to costly techniques and inputs that are being used in these institutions. Most of these institutions owe their existence to private enterprise and most of the students enrolled in them come from high income and social groups. So costly techniques and inputs are used to gain acceptability of those who demand places in such institutions. The decrease in the unit costs of these institutions during the period under consideration must be due to the rate of growth of enrolments at a faster rate than the rate at which expenditure incurred on them might have grown.

(ii) A place in the colleges of professional education costs a little more than twice as muchas a place in the colleges for general education.

(iii) A surprising feature is that the unit costs per student in universities are much less than the unit costs in colleges of general education. It must be due to the existence of suboptimal colleges. A lot of educational expansion has taken place in India due to private inititive and enterprise. It is but natural that most of the private institutions have been located at places where some person (s) could arrange financial resources to start a new institution. Many of the public institutions also were created due to political pressures and other pull and push factors which resulted in the mis-location of many of these institutions. Thus, in the absence of a well-conceived and pre-determined policy frame, a situation has been brought about where there are many institutions which compete for a few students and there are very few institutions or no institutions in many areas which have many students competing among themselves to find places in these institutions.[13] There is empirical evidence to show that a number of colleges belong to this category and many of them operate at sub-optimal levels which enhances their operational unit costs.[14] This highlights the necessity of an appropriate policy of location of educational institutions.

As for the changes in the unit costs over time, the total average unit cost of all levels and types of education taken together has increased

13. Cf. Fact Book of Manpower, Vol. II, P 37.

from Rs 50 in 1951 to Rs 67 in 1964, its rate of growth being 34 per cent. The average direct cost has also gone up from Rs 40 to Rs 52 during the same period, its growth rate being 30 per cent. Share of indirect expenditure in the total educational expenditure seems to have increased more than proportionately. The compound growth rates have the highest values for the period from 1951 to 1956 but decline rapidly in subsequent years for all institutions. The cost per pupil of pre-primary schools, middle schools and colleges of technical and professional education decline substantially, whereas the unit costs of all other institutions increase during the same period, their rates of growth ranging between 7 and 21 per cent. The question is what factors make the unit costs of these institutions grow negatively. Let us examine the growth of enrolments, institutions, expenditure, students enrolled per institution and expenditure incurred per institution at constant 1960-61 prices (see table below).

After 1955-56, pre-primary schools increased at rates far greater than the rates of growth of enrolments as well as expenditure. This resulted in smaller number of students and less amount of expenditure per school. It means that the exponential proliferation of pre-primary schools to meet the requirements of ever-increasing number of students lowered

Type of Education	*Year*	*Growth Rates*			*Expenditure Per Institution*	*Students Per Inst.*
		Enrolments	*Institutions*	*Expenditure*		
Pre-Primary					(In 000)	
	1950-51	—	—	—	4.6	71
	1955-56	111.8	107.9	108.6	4.6	73
	1960-61	460.0	530.0	322.0	3.1	63
	1963-64	726.2	794.4	457.4	2.9	66
Middle						
	1950-51	—	—	—	6.6	152
	1955-56	83.9	59.8	100.1	8.2	175
	1960-61	411.9	265.3	380.0	8.6	214
	1963-64	597.5	382.4	477.7	7.9	220
Professional Colleges						
	1950-51	—	—	—	187.8	312
	1955-56	78.5	32.6	65.9	235.0	419
	1960-61	215.6	226.4	222.5	185.5	302
	1963-64	322.1	341.8	326.1	181.1	296

14. In 1964-65, 52.6 per cent of the collages of general education had less than 500 students, 36.6 per cent had less than 300 students and 11 per cent had even less than 100 students on their rolls. See, Education Commission Report : Education and National Development, Hindi Edition, 1968, P. 351.

the scale of facilities. But the expenditure incurred on middle schools increased throughout the entire period at rates much faster than the rates of growth of middle schools. It should have meant increased expenditure per school in all the years subsequent to 1951. But the growth of enrolments also exceeded the growth of institutions, with the result that the schools became much more crowded than before. Besides, the enrolments in middle schools grew faster than the expenditure incurred on them. The result is that whereas the number of students per school increased at 41 and 45 per cent, the expenditure per school grew only at 31 and 20 per cent respectively in 1961 and 1964. This reduced the unit cost per student enrolled in middle schools substantially but at the cost of more crowding of schools, provision of fewer teachers and other facilities for the ever-rising number of students.

Similarly, the growth of the colleges of professional and technical education during the period 1956-64 outstripped the growth of enrolments as well as expenditure. Consequently, both the number of students and the expenditure per college tended to decrease. Less amount of expenditure per institution must have meant the provision of equipment and other facilities at reduced sales. In other words, it means a proliferation of sub-standard institutions.[15] Many of these institutions had failed to attract sufficient number of students. There is empirical evidence to support this inference. In 1964-65, 78 per cent of the professional and technical colleges in India had less than 500 students, 68.1 per cent colleges had less than 300 students and 28.6 per cent colleges had even less than 100 students on their rolls.[16] If such a large proportion of professional and technical colleges failed to attract the sufficient number of students during a period when the enrolments increased at more than 200 and 300 per cent, it means that either these colleges are located in areas where there is little demand for such education or the students could not be attracted by these institutions due to their sub-standard character or both. No doubt, the attractiveness of some of the professional and technical courses, particularly the engineering ones, has been reduced substantially in recent years due to widely prevalent unemploy-

15. The rapid expansion of facilities and the number of institutions of technical education in recent years has caused a serious setback to the amount of resources available to the existing institutions. According to the 1964 Survey, engineering colleges and polytechnics faced shortages to the extent of 35 per cent teachers, 53 per cent equipment, 51 per cent buildings and 55 per cent hostels. See, Fourth Five Year Plan : Draft Outlines, (Hindi), Planning Commission, Govt. of India, 1966, P 226.

16. Education Commission, Report ; Education and National Development, (Hindi), P. 351.

ment among the technically qualified manpower. It might have also affected the demand for places, particularly in those technical and professional institutions which are not regarded to be the esteemed ones. Thus, we find that the decrease in unit costs of all levels and types of institutions has been caused by a deterioration in the quality of these institutions. The quantitative expansion has, therefore, been at the cost of quality.

The reciprocals of the unit costs of education express the number of students enrolled per rupee worth of educational expenditure. An increase in costs means a decrease in the number of students enrolled per rupee worth of educational expenditure. For example, an expenditure of Rs 1000 on universities could provide enrolments to 5.7 students in 1951, whereas the same amount could provide enrolment to 4.7 students only in 1964. Other figures can be interpreted similarly. Only pre-primary schools, middle schools and professional and technical colleges show an increase in the number of students enrolled per rupee worth of expenditure incurred on them.

Conclusion

The results of the study show that the productivity of the Indian educational system as measured by the number of passes per student enrolled and the teacher-students ratios records an improvement, whereas the educational productivity defined as the reciprocal of the unit costs shows a decrease for most of the institutions during the same period. While the flow coefficients of education seem to have been taken care of by quantitative expansion, there seems to be a tendency to dilute the standard of stocks with the educational institutions.[17] After all, we can expect such a development in a capital scarce and labour abundant economy, like the Indian one. The opposite trend shown by the different measures of the productivity is perhaps due to the differences relating to the concepts and also due to the fact that one measure of productivity relates to the institutions of various levels and types of education whereas the other two measures are related to the various levels and types of education. Then, the inputs and outputs of the educational processes in the three cases measure items that are different. Therefore, the results yielded by the three measures of educational productivity are not comparable.

17. Neither the demand could be checked nor the necessary resources could be arranged... there are very many instances where the institutions were started without making provision for adequate number of teachers, necessary materials and appropriate financial allocations. Education Commission, Report : Op. Cit., PP 102-103.

On Value Assurance as The Total System Objective

Prem Vrat,

Starting from Taylor's concepts in scientific management, the entire managerial decision making process has undergone a remarkable change due to the innovations in the management techniques for better decisions and controls. The objective(s) used in the various productivity techniques vary from maximisation of profits to minimisation of costs, maximisation of output, minimisation of inputs, quality-improvement and cost-reductions. It is felt that in these objectives there may be a possibility of overlooking all aspects of the system's operation. For example in quality control, there may be emphasis on controlling quality without any regard for the cost of quality control. But this cost-benefit aspect must be in-built in any managerial objective. Even the management objectives like profit maximisation etc., are not adequate, partly because they tend to consider only the objectives of the corporation, whereas in a realistic sense a "Total System Approach" is needed where corporation objectives become a part of the total system objective. Then most objectives practiced are incomplete. A value or utility concept is more generalised and broad-based because it is customer-oriented and all other objectives have to be necessarily a part of the broad total objective —viz., *Value Assurance.* Hence, the author feels that a more complete objective under any context of system's operation is the Value Assurance.

This paper highlights the importance of management by value assurance as the objective and reviews some concepts of engineering the value to the products and systems, for improved value assurance.

Historical Background

Value engineering or value analysis is one of the most powerful and versatile weapons added to modern management's arsenal for cost reduction. The value analysis concept is the product of World War II

and the term was coined by a staff engineer, Lawrence D. Miles, together with the vice-president of General-Electric, Harry Erlicker, in 1947. The methodology worked out by Miles for improving the value was successfully applied to various projects resulting in huge cost reductions. The techniques then spread to other American industries and a Society of American Value Engineers (SAVE) was formed.

The value analysis is an organised approach for challenging unnecessary costs of products and procedures. It is a philosophy implemented by the use of a specific set of techniques, a body of knowledge and a group of skills for efficient identification of costs which do not contribute to value.

Concepts and Significance of Value

The concept of Value Analysis is not new. It only employs a new methodology with an old attitude for building value into the product. The term value is an abstract concept and a number of definitions have been suggested. Value is sometimes taken as synonymous to utility or monetary worth. Miles defined the economic value as "the lowest price you must pay to provide a reliable function or service". In fact, value is a concept which depends on the following factors :

(a) Quality and appearance;

(b) Cost or the selling price;

(c) Availability;

(d) Reliability and after sales service;

(e) Operational costs;

Thus, in value analysis the objective is to achieve the intended function without affecting adverse changes in quality, reliability etc. at the minimum cost. There have been various terms in use like, value engineering, value analysis, value administration and value management and attempts have been made to distinguish one term from the other, but this author feels, that all these terms are more or less synonymous, and in fact, a better term "Value Assurance" may be used. The value assurance then becomes a policy, a management objective to be accomplished and in

doing so all other management techniques may be used to achieve this single complete objective. Thus a tentative definition of value assurance may be given as follows :

"Value Assurance is an objective which aims to achieve the equivalent system performance at minimum overall cost. This is accomplished by efficiently identifying the hidden, unnecessary costs components which do not contribute to value and eliminating these by using an organised creative approach, employing a package of management and technical skills in all aspects of the design, procurement, manufacture and operation of a product or a system."

Value Assurance : An Objective

The above definition of value assurance makes it an objective to be accomplished. Seeing the concept of value, one can readily recognise that improved value can almost be the sole and complete objective in any managerial decision context and other objectives being practiced become a part of this main objective. This is important because with value as the objective there is no possibility of overlooking any aspect of the system nor is it possible to have sub-system objectives working at cross-purposes. Hence, value assurance is an objective which views the objectives in its totality and all other organisational objectives become a sub-set or a part of it.

Value Assurance for Improved Productivity

If the value of a product or a system is improved this would mean either better quality, reliability, appearance, maintainability and availability for the same cost or lower cost, for the same level of quality and reliability and other factors. This means that improved value would necessarily mean an increase in the productivity and in that sense the term "Value Assurance" may be viewed as synonymous to "Productivity" because both can be regarded as the 'complete-in-itself' objective to be aimed at, but the term "Value Assurance" is more convincing because productivity may be confused with production and the ratio output/input is too general and does not emphasise explicitly that increased output should not be at the cost of reduced reliability and deteriorating

quaiity, whereas, the concept of value is more explicit and less confusing.

Value assurance focuses attention on and calls for rational selection and procurement of raw materials, design engineering, manufacturing subsystems and management staff to achieve the equivalent performance at the lowest cost, and needs an inter-disciplinary approach, and a coordinated effort to accomplish this single complete objective. The objective being customer-oriented, can be achieved by providing him the right value for the price he pays. He would not like to pay for the unnecessary features which do not add any value to his requirements and specifications. Since customer needs are the main consideration in value assurance, this is the only way of survival of the business, particularly, in a perfectly competitive market.

Reasons of Poor Economic Value

L.D. Miles suggested 10 value tests to be applied to any product, procedure or a system to know whether its value can be improved. He observed that if honestly applied these value tests would indicate that about 99% of the products and systems provide a scope for value improvement. What could be the possible reasons for such a sorry state of affairs in engineering value to the products? Probably, the most important reason is the lack of organised effort to wage a war against the poor value areas and eliminate the hidden or unnecessary cost components completely. In this sense the value assurance concepts provide only an organised approach and in fact it is the biggest contribution of value analysis. Some other possible reasons for poor value may be as follows :

(a) Lack of time or "design under panic environment". Poor value in design may result because of very little time given to the system designer and under this tight schedule he aims at a workable design with additional features incorporated in it to play safe. Thus the economic aspect is almost ignored under a pressure of meeting a schedule whereas any development requires certain minimum time for getting ideas and choosing the most rational design concepts, materials and specifications.

(b) Temporary decisions and long after the conditions that generated these decisions, the results continue to foster non-functioning unnecessary cost.

(c) Lack of essential information and the poor authenticity of the information.

(d) Reluctance to seek advise or consulting others is considered as a sign of weakness. Value assurance concepts turn the so called weakness into valuable asset.

(e) Human factors—personal inertia, predetermined reactions, mental roadblocks, non-generation of creative ideas, habits and attitudes, honest but wrong beliefs are some of the human and psychological factors which come in the way of value assurance.

Systematic Approach for Value Assurance

Miles[1] came out with a Philosophy to have an organised attack on poor value areas and developed "Value Engineering Job Plan". This job is a systematic approach which is essential for solving any problem scientifically. Starting from method study steps of SREDIM, the job plan has since been refined, modified and improved. Central Labour Institute at Bombay[2] has suggested a DARSIRI approach. The approach suggested by Mudge[3] is probably more complete and takes care of the psychological factors under the "General Phase" which is the basic foundation over which structure can be built. The brief review of the various phases and the associated techniques are as follows :

1. General Phase : It is present throughout the project and only upon a sound general phase the other phases of the scientific study will prove useful. The techniques of general phase are; (a) use good human relations; (b) inspire team work; (c) work on specifics (avoid

1. Miles, Lawrence D., "Techniques of Value Analysis and Value Engineering", Mc-Graw Hill, 1970.
2. Central Labour Institute Bombay, "DARSIRI" method of Value Analysis, Productivity, Vol. X, July-Sept, 1969.
3. Mudge, Arthur E.—"Value Engineering : A Systematic Approach "John Wiley, 1970.

generalities); (d) overcome roadblocks; and (e) Apply good business judgement.

2. *Information Phase :* This is the most time-consuming and difficult phase. The three techniques in this phase are—(a) secure the facts; (b) determine costs; and (c) fix costs on specifications and requirements.

3. *Function Phase :* The functional approach employs two techniques to define the exact function of the product, procedure or the system. They are : (a) Define the function using a verb and a noun. This ensures the most precise description of the functions. Also describe the functions into "use" functions, "sell" functions. (b) Evaluate functional relationship. Through this numerical technique a descending order of importance is established for various "basic" and "secondary" functions. This also helps in separating the functions because of specifications and those because of present design.

4. *Creative Phase :* In this phase new value alternatives are generated. The two useful techniques for being creative in value assurance are : (a) Establish positive thinking, divorcing the creative part of mind from the judicial one : (b) Develop creative ideas, by brain storming and using idea stimulators and various check lists.

5. *Evaluation Phase :* Here the judical part of the mind is brought into use. The techniques under this phase are : (a) Refine and combine ideas; (b) Establish cost on all ideas; (c) Develop function alternatives; and (d) Evaluate by comparison.

6. *Investigation Phase :* This phase converts the selected idea into workable and saleable solutions providing lower cost methods of performing the desired functions. The techniques of this phase are : (a) consult vendors and specialists; and (b) use speciality products, processes, procedures.

7. *Recommendation Phase :* It is an important phase because the acceptance of a proposal depends very much upon the way they are put up, supported by the factual data and potentials for savings. The techniques of this phase are : (a) Present facts; (b) Present costs; and (c) Motivate positive action.

Value Assurance and Decision Environment

In the GIFCEIR phase of value assurance suggested by Mudge (as shown above), the creativity plays an important role, followed by the evaluation of value alternatives. All efforts for value assurance require tremendous amount of information to be collected and, therefore, calls for a systematic and streamlined record of relevant information from time to time. This decision environment is essential because in the absence of data no decisions can be rationally arrived at.

Apart from the availability of data the concepts of decision theory can be gainfully utilised in the evaluation phase of this systematic approach. In fact, the quantitative techniques could be used for evaluating the feasible solutions to decide about the preferred solution. Particularly, the decision-tree, function-cost matrix[4] and the "decision-matrix[5] can be gainfully employed in the evaluation stage. The decision matrix is an extremely useful quantitative tool for evaluating the strategies or choices against a number of factors, objectives and arrive at the optimal value decision which satisfies all the objectives simultaneously in the order of importance attached to these factors or objectives. Since most managerial decisions have to be taken into the context of multiplicity of objectives present, the decision-matrix helps in almost all types of value assurance situation.

To conclude there appears to be an urgent need to realise that the philosophy under-lined by the value assurance concept is much more than it.

4. Raven A.D.—"Profit Improvement by Value Analysis, Value Engineering and Purchase Price Analysis "Cassell, London 1970.

5. ASTME—"Value Engineering in Manufacturing", Prentice Hall, 1965.

Anatomy of Overheads

P. Chattopadhyay

In the overall scheme of managerial cost control, overheads occupy a significant place. Apart from the complexities and laborious effort in tracking down the various overheads, sheer magnitude of overheads in an accounting period makes overheads and their control burning issues in an industrial organization. By definition, overheads are those items of expenditure which cannot be attributed to a cost unit or a cost centre and can only be apportioned on an agreed basis.

A Complex Task

Overheads generally elude the grasp of control devices in so far as by nature overheads are those expenses which have only an indirect relationship with production and cannot be attributed to particular products or processes except by way of apportionment. This involves elements of subjectivity in many cases. Overhead costs as such have to be apportioned with reference to the nature of the items and their magnitude in each case. Control of overheads has assumed significance because most of these items tend to be rather centrifugal in behaviour and have to be kept on track by deliberate action. In the context of the increasing capital intensity of modern, growth-oriented industries in which the direct costs tend to be smaller than indirect costs, overheads tilt the ultimate advantage or otherwise. This is understandable and relevant in India in both public and private sector enterprises in which even direct labour is a fixed expense and requires to be apportioned. Intra-firm variations over time and inter-firm variations at a point of time have made tasks of control intricate and difficult.

In most modern, growth-oriented industries the stress is on increasing the value added during the course of manufacture. The process of value addition is, however, not simple. In general, it embraces large part of those expenses which cannot be directly allocated to cost units or cost centres. Direct labour is embraced by added value as is indirect labour.

In the circumstances, their control also becomes a highly complex phenomenon. This is because of essentially two factors. First of all, the control is required to be itemized and detailed depending on the magnitude of each item. Secondly, the control is stressed with reference to the facilities provided and the costs thereof, as against pre-determined norms. In addition, the budgetary control mechanism takes care of the facilities so provided in physical and financial terms and the variations from budget targets are sought to be explained with reference to the factors that have played a part in either pushing these expenses up or pulling them down. Normally, in the day to day control mechanism, reference is not made to their link with the production of the organization. It appears by the nature of overheads that the provision and control of overheads have a momentum distinct from that of production. In the circumstances, control of overheads acquires a meaning not always adequately realized. In our country, this control is still rather primitive in both sectors of the economy.

From the point of view of control, overheads comprise a genus having a large number of species under it, in the sense that the large number of items falling under overheads show different behavioural patterns as regards their incidence on cost, bases of apportionment to cost centres or cost units and tracing of the effectiveness of each itemtal *vis-a-vis* the cost thereof Thus, in controlling overheads, management is confronted with the task of having to locate the physical facilities, to identify the costs and to properly accumulate them for ultimate apportionment to cost centres or cost units. The traditional control devices, including budgetary control, do not seem to be quite adequate for this purpose. From the cost accounting angle, the difficulty is further aggravated by the fact that the physical overheads facilities remain generally untracted and control is sought to be exercised in lump. Establishment of quantitative criteria for purposes of control of both costs and effectiveness of these physical overheads facilities is an essential step that is not generally taken in most cases. Secondly, since the momentum of growth of these physical facilities appears to be distinct, it is necessary that some linkages are also established before final apportionment to the cost units or cost centres. so that before the final stage, it is possible to connect and adequately control overhead expenditure. This requires deliberate management planning.

Budgetary Control Not Enough

Each of the items under overheads may be seen from different points of view. First of all, these items are subject to varying degrees of efficiency. Secondly, each can be gauged with reference to input and output as a physical measure, howsoever imprecise it may be. Thirdly, these items are subject to ABC analysis from the point of view of managerial control. Fourthly, different types of physical and financial norms may be found appropriate for different items. Last but not the least, the budgetary system is not always adequately geared up for dealing with overheads expenditure when the individual items are numerous. Management approach towards control of overheads thus often lacks the sensitivity necessary for the purpose. Effective control of overheads would contribute substantially to the overall control exercised by management on the operations of an enterprise. The typology of overheads has been indicated in Chart I. From the point of view of control, focus is required to be put on each type with reference to its importance, the set up created for each, the basic decisions taken thereon, their relative proportion to the total cost incurred over time as also to that of the products manufactured during the concerned period either on the basis of individual products or on that of the product lines.

Setting up of Relative Priorities

Depending on the nature of activities in the organization, the relative importance of different types of overheads would vary. The control procedure would, therefore, have to accommodate these variations in proper light. In this context, determination of relative priorities of individual items of overheads under different types is not only complicated but also delicate in so far as the effectiveness of control in these areas would influence the ultimate results in a significant way. Here one may mention the application of ABC analysis in the context of control of overheads. Depending on their significance some items of overheads may have to be subject to itemized control while several individual items may be grouped together for control by batch or type, particularly, in those cases where the individual items do not command much significance or magnitude. Application of ABC analysis in this context would provide management with more effective means of having a close watch on overheads, particularly, the significant items, while the other items might

be left out of the purview of strict control. In determining whether an item is A, B or C, management requires taking into consideration the magnitude of expenditure, the lead time in procurement of these items especially when imported, the nature and magnitude of consumption and such other considerations. Lumping all these items together may keep some crucial items out of focus while relatively unimportant ones might claim larger attention.

Among the overheads there are several items which are generally heavy, under each of the various types mentioned in Chart I. ABC analysis may be applied in each for enhancing efficacy of control at least over those items which count seriously. Moreover, the A and B items in each category may be related to the concerned activities in terms of their proportion to the total as also of the magnitude of the achievements in the related spheres such as total quantum of production, value of production, sales, quantum and value of products distributed through various channels, total administration overheads, etc., during a period of time. Even in budgets, these items may be dealt with in such a way as would take account of these relationships. On the basis of these relationships, realistic norms might be established for watch and control of periodic movements. In this context, the fixed and variable overheads would require segregation so that different yardsticks might be adodted for appraising performance over time The variances noticed would require close examination and corrective measures taken with reference to their points of occurrence. The budgetary process is shown in Chart II. Emphasis here is on analysis of variances and proper corrective action.

According to text books, direct labour is prime cost which is variable. The distinction between direct and indirect labour is based on this fact. But in conditions obtaining in this country, labour is a fixed cost being in major part based on time scale. It cannot be allocated to cost centres or cost units; it can only be apportioned. In the circumstances, cost accounting for labour would require a basic change in attitude and managerial practices. With labour, almost the whole of it, as an overhead, focus on control of overhead should be much sharper than it is now. The concept of marginal costs and direct costs and the accent on scale economies undergo a revolutionary change in character. Overheads can hardly be left to take care of themselves in these conditions, which call for adequate measures for enhancing their cost-effectiveness and basic changes in managerial policies.

CHART I

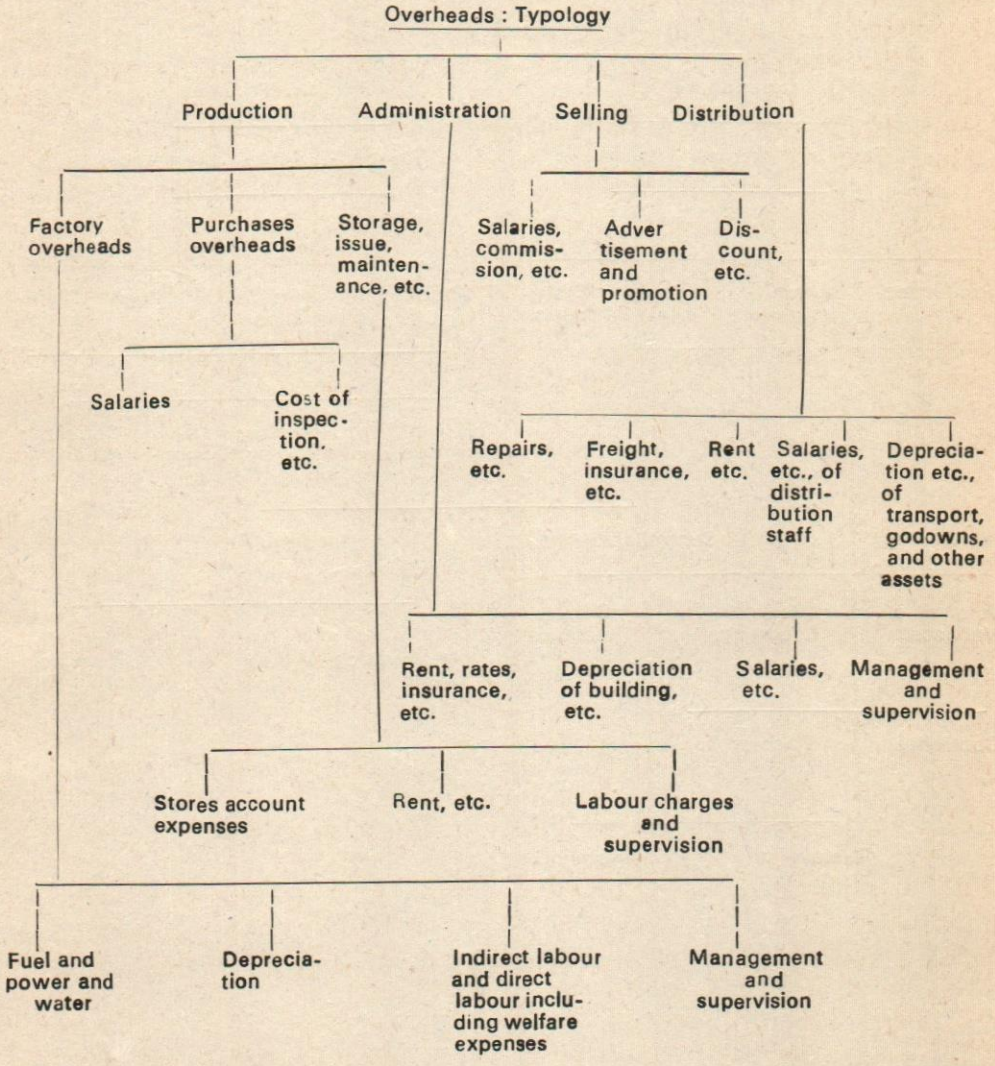
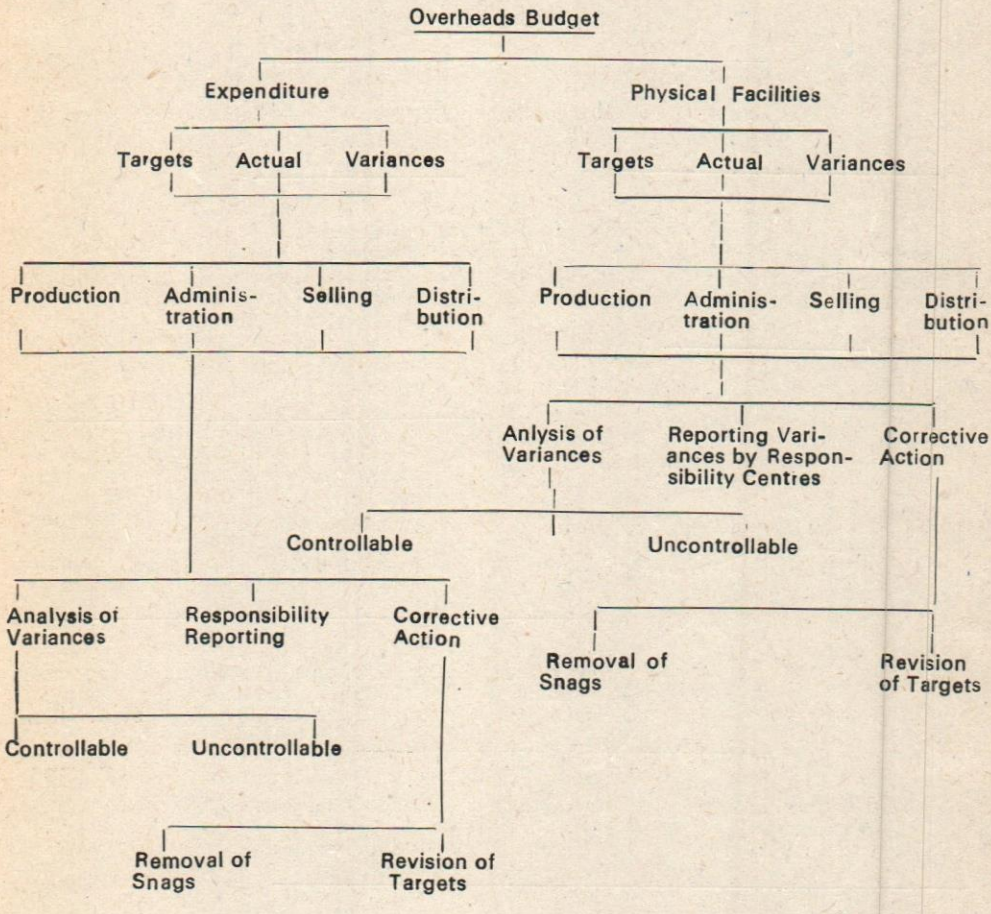

Overheads : Typology
Production
Administration
Selling
Distribution
Factory overheads
Purchases overheads
Storage, issue, maintenance, etc.
Salaries, commission, etc.
Advertisement and promotion
Discount, etc.
Salaries
Cost of inspection, etc.
Repairs, etc.
Freight, insurance, etc.
Rent etc.
Salaries, etc., of distribution staff
Depreciation etc., of transport, godowns, and other assets
Rent, rates, insurance, etc.
Depreciation of building, etc.
Salaries, etc.
Management and supervision
Stores account expenses
Rent, etc.
Labour charges and supervision
Fuel and power and water
Depreciation
Indirect labour and direct labour including welfare expenses
Management and supervision

CHART II



Note : ABC analysis in the above context may mean that separate budgets may be prepared for A items and for some of the B items; and for C items, groups or batches of items may comprise a budget under each different function stated in Chart I. Alternatively, separate budgets for A and B as also C items may be prepared under each head shown in Chart I. Chart II presupposes the operation of a well designed budgetary control system in the enterprise incorporating both physical and financial aspects of performance.

Evolve a Tailor made System

The magnitude of overheads of various types differs with varying labour or capital intensity. The emphasis on control of overheads should, therefore, be in consonance with the characteristic features of each organization. Thus, effective control of overheads may logically result in lowering down capital costs of projects under construction where such overheads are ultimately capitalized; an indifferent attitude may escalate capital costs that remain as built-in disadvantages. A unit with the head office at one place and plants and other offices scattered at other places may show high travelling expenses, necessitated by requirements of coordination. Economizing thereon while still attending to the needs of coordination may lead the unit to adopt various alternative means of communication, such as trunk telephone or telex, obviating the need for travelling frequently. It needs little repetition that the higher the capital intensity, the greater the amount of depreciation and the expenditure on preventive maintenance. Similarly, the older the unit, the larger the expenditure on breakdowns, repairs and renewals; and the larger the size of market, the bigger the expenses on distribution.

The typicalities of each organization would reflect on the size of overheads in the aggregate as also on the various items of overheads. Managerial control would require to be sensitive enough to ensure that the expenses on overheads do not go out of hand while the cost of their control is not excessive. Sorting out the major ones for itemized control and the less important one for non-itemized control as envisaged in ABC analysis is, therefore, an essential step towards improved economies of operations in an enterprise irrespective of its size or nature of operations. This would also lead to better application of control techniques.

Productivity in the Indian Fertiliser Industry*

While the performance of the Indian Fertiliser Industry as compared to the performance of the total manufacturing sector in the country can be regarded as satisfactory and efficiencies of some of the new plants can well be compared with their counter-parts in developing countries, the overall productivity of Indian Fertiliser Industry compares unfavourably with that of the developed nations. This document which is based on a paper prepared by the Fertilizer Association of India attempts to measure productivity and analyses the reason for low productivity in the Indian Fertiliser Industry. It is hoped that the document will throw some new insights into the problems of the Fertiliser Industry and might also provide a few guidelines for future action. *—EDITOR*

It is generally said that the productivity in the Indian Fertiliser Industry is low. But very rarely, if ever, has this observation been substantiated by any meaningful comparison with conditions obtaining in the fertiliser industry in other parts of the world. Such a comparison has been made more difficult by lack of ready availability of suitable data.

In India, we have a heterogeneous mix of plants each having its own characteristics. Units vary in age, some of these being well over 25 years. Our domestic plants are based on different feedstocks; they have adopted different processes even with the same feedstocks. Their sizes vary from literally a pigmy (at least by today's standard) to giants even by world standards. Nor is the product mix the same in all the plants. Quite a diversity indeed, dictated undoubtedly by a host of reasons. Under such circumstances, a discussion of the overall capacity utilization is likely to be misleading.

It would be useful to categorize the existing plants into various groups which would lend to each unit therein certain amount of similarity, and then analyse the productivity group-wise. We have split the existing units into the following six groups, according to ; (i) age, (ii) size, (iii) feedstock used, (iv) process adopted, (v) product mix, (vi) importance of fertiliser output relative to its overall operations, and (vii) plants having captive power source.

* Modified from Fertilizer News, March 1975. Prepared by the Fertilizer Association of India.

For purpose of convenience we have taken into account the production performance of all the domestic nitrogenous, phosphatic and ccmplex plants during the Fourth Five Year Plan period, namely, 1969-70 to 1973-74. Their capacity utilisation (productivity) as percentages is given in Table 1.

According to Age

The existing plants have been categorised under four 'Age Groups'—pre-1960; between 1960 and 1965; between 1965 and 1970 and post-1970. This plantwise—yearwise productivity given in Table I has been rearranged according to the age of the plants in Table 2. It is generally accepted that operations in a new plant take 2 to 3 years to stabilise. It is, therefore, not unreasonable to expect that production in units like MFL, Goa, Cochin and Durgapur had not completely stabilised during the period under review.

An examination of the data given in Table 2 clearly shows that the production performance of the plants established before 1960 is distinctly lower than the others. In each of the next two groups, while there is considerable disparity between the performances of various plants, with some plants in the third category (i.e., those set up between 1965-70) faring worse than the older plants, there is no denying that the average performance of the latter plants appears to be much superior to the earlier plants.

The average performance for 1972-73 of the plants established between 1960 and 1965, works out to 63 per cent and that for 1973-74, 62 per cent. The corresponding figures for the units established between 1965 and 1970 excluding Neyveli (as it has continuously suffered from problems of raw materials and other technological problems) are 87 and 77 per cent respectively. It is obvious that the newer plants have performed much better than the older ones. It can be safely asserted from this analysis that the older the plant, the poorer its performance. Conversely, productivity in more modern plants is distinctly better. This phenomenon is, due, *inter se*, to two predominant factors, i.e., improved technology and better physical fitness due to younger age of plants. This is the reason for rapid obsolescence in advanced countries, particularly, for chemical industries.

Table 1 :Percent Capacity Utilisation of Nitrogenous and Complex Fertiliser Plants in India during the Fourth Plan Period

(April-March)

Plant		1969-70	1970-71	1971-72	1972-73	1973-74
1. FACT, Alwaye	N	43	33	40	35	44
	P_2O_5	41	33	33	30	47
2. FCI, Sindri	N	63	63	49	62	65
3. NCJML, Varanasi	N	30	59	46	35	40
4. FCI, Nangal	N	100	69	71	67	77
5. HSL, Rourkela	N	25	20	39	40	38
6. EID-Parry, Ennore	N	60	54	69	73	65
	P_2O_5	70	57	80	85	77
7. FCI, Trombay	N	49	78	85	75	69
	P_2O_5	38	67	113	100	89
8. NLC, Neyveli	N	61	46	28	30	21
9. GSFC, Baroda	N	51	68	86	94	75
	P_2O_5	41	48	47	61	55
10. CFL, Vizag	N	85	94	81	74	68
	P_2O_5	88	79	88	85	84
11. FCI, Namrup	N	56	60	66	75	80
12. FCI, Gorakhpur	N	91	85	95	83	80
13. SCI, Kota	N	72	102	98	116	100
14. IEL, Kanpur	N	9	54	64	80	57
15. MFL, Madras	N	—	—	22	64	76
	P_2O_5	—	—	31	63	61
16. ZACL, Goa	N	—	—	—	—	45
17. FACT, Cochin	N	—	—	—	—	9
18. FCI, Durgapur	N	—	—	—	—	3
19. Coke Ovens	N	60	60	55	60	
20. Single & Triple Supherposphate Factories	P_2O_5	47	45	55	61	54
	N	53	63	62	70	54
	P_2O_5	52	53	56	66	56

Ref : Fertiliser Statistics, FAI, 1968-69 to 1972-73.

Table 2 : Fertiliser Plants According to Age

Plant	Per cent capacity utilisation				
	1969-70	1970-71	1971-72	1972-73	1973-74
(a) Established before 1960					
1. FACT, Alwaye	43	33	40	35	44
2. FCI, Sindri	63	63	49	62	60
3. NCJM, Varanasi	30	59	46	35	40
(b) Established between 1960 and 1965					
4. FCI, Nagal	100	69	71	67	77
5. HSL, Rourkela	25	20	39	40	38
6. EID-Parry, Ennore	60	54	69	73	65
7. FCI, Trombay	49	78	85	75	69
(c) Established between 1965 and 1970					
8. NLC, Neyveli	61	46	28	30	21
9. GSFC, Baroda	51	68	86	94	75
10. CFL, Vizag	85	94	81	74	60
11. FCI, Namrup	56	60	66	75	80
12. FCI Gorakhpur	91	85	95	83	80
13. SCI, Kota	72	102	98	116	100
14. IEL, Kanpur	9	54	64	80	57
(d) Established after 1970					
15. MFL, Madras	—	—	22	64	76
16. ZACL, Goa	—	—	—	—	45
17. FACT, Cochin	—	—	—	—	9
18. FCI, Durgapur	—	—	—	—	3

Ref : Fertiliser Statistics, FAI, 1968-69 to 1972-73.

According to Size

The existing units have been classified under four sizes, namely, below 50,000 tonnes per annum of nitrogen, between 50,000 to 100,000 tonnes, between 100,000 to 200,000 and over 200,000 tonnes. The relevant

data is presented in Table 3. Although it is not possible to arrive at any definite conclusion, it would appear that the performance of the stabilised plants with a capacity exceeding 100,000 tonnes has been marginally better than the rest.

Table 3 : Fertiliser Plants According to Size

Plant	Per cent capacity utilisation				
	1969-70	1970-71	1971-72	1972-73	1973-74
(a) Capacity over 200,000 tpa N					
1. GSFC, Baroda	51	68	86	94	75
(b) Capacity between 100,000 and 200,000 tpa N					
2. HSL, Rourkela	25	20	39	40	38
3. SCI, Kota	72	102	98	116	100
4. IEL, Kanpur	9	54	64	80	57
5. MFL, Madras	—	—	22	64	76
6. ZACL, Goa	—	—	—	—	45
7. FACT, Cochin	—	—	—	—	9
8. FCI, Durgapur	—	—	—	—	3
(c) Capacity between 50,000 and 100,000 tpa N					
9. FACT, Alwaye	43	33	40	35	44
10 FCI Sindri	63	63	49	62	63
11. FCI, Nangal	100	69	71	67	77
12. FCI, Trombay	49	78	85	75	69
13. NLC, Neyveli	61	46	28	30	21
14. CFL, Vizag	85	94	81	74	68
15. FCI, Gorakhpur	91	85	95	83	80
(d) Capacity below 50,000 tpa N					
16. NCJM, Varanasi	39	59	46	35	40
17. EID-Parry, Ennore	60	54	69	73	65
18. FCI, Namrup	56	60	76	75	80

Ref : Fertiliser Statistcs, FAI, 1968-69 to 1972-73.

According to Feedstock Used

All the existing plants have been reclassified as (a) naphtha-based, (b) coke and lignite–based, (c) natural gas, refinery gas and cokeoven gas-based, (d) electricity–based, and (e) based on more than one feedstock

Table 4 : Fertiliser Plants According to Feedstock

Plant	*Per cent capacity utilisation*					*Remarks*
	1969-70	1970-71	1971-72	1972-73	1973-74	
(a) Naphtha as feedstock						
1. FACT, Alwaye	43	33	40	35	44	
2 EID-Parry, Ennore	60	54	69	73	65	
3. GSFC, Baroda	51	68	86	94	75	
4. CFL, Vizag	85	94	81	74	68	
5. FCI, Gorakhpur	91	85	95	83	80	
6. SCI, Kota	72	102	98	116	100	
7. IEL, Kanpur	9	54	64	80	57	
8. MFL, Madras	—	—	22	64	76	
9. ZACL, Goa	—	—	—	—	45	
10. FACT, Cochin	—	—	—	—	9	
11 FCI, Durgapur	—	—	—	—	3	
(b) Coal, coke, lignite as feedstock						
12. FCI, Sindri	63	63	49	62	62	Using also naptha
13. NCJM, Varanasi	30	59	46	35	40	
14. NLC, Neyveli	61	46	28	30	21	
(c) Natural gas, refinery gas and C.O.G.						
15. FCI, Namrup	56	60	66	75	80	
(d) Electricity as feedstock						
16. FCI, Nangal	100	69	71	67	77	
(e) Using more than one feedstock						
17. FCI, Sindri	63	63	49	62	62	Coal naphtha, C.O.G.
18. HSL, Rourkela	25	20	39	40	30	C.O.G., naptha
19. FCI, Trombay	49	78	85	75	69	Naptha, refin. gas

Ref : Fertiliser Statisties, FAI, 1968-69 to 1972-73.

(ref. : Table 4). In the last category are included plants like Sindri which use coke, coke-oven gas and naphtha, the Rourkela plant which uses coke-oven gas and naphtha, and the Trombay plant which uses refinery gas and naphtha.

It may be seen from Table 4 that except FACT, the rest of the naphtha-based plants (barring Goa, Cochin and Durgapur where production is yet to stabilise), have been performing well. The average capacity utilisation of the plants at Ennore, Baroda, Visakhapatnam, Gorakhpur, Kota and Kanpur during 1972-73, at around 86 per cent is good by any standard.

The performance of plants based on coke and lignite as feedstock has been very poor (averaging about 42 per cent). The only plant based completely on natural gas is the FCI unit at Namrup. Although its performance has improved over the years, its best achievement so far has been only about 80 per cent compared to the average of 86 per cent of the plants based on naphtha. Normally, plants based on natural gas, perform much better than those based on other feedstocks. The comparatively low productivity of the Namrup plant is unusual and is attributed to inadequate and irregular supply of electric power from the State Electricity Board.

The Nangal Plant is based on electrolysis of water. It has worked to 100 per cent capacity whenever the full power required, namely, 164 MW, is made available to the plant. Its low productivity in the last four years is only due to the shortage of power.

The plants using more than one feedstock have not performed satisfactorily. This is understandable as considerable complications arise due to multiplicity of processes to be adopted when more than one feedstock is to be processed in the same plant. Among the units in this category, the performance of Trombay unit is distinctly superior to the others.

Indian experience points to the need for a single feedstock for each unit and the plant being designed accordingly. Of these, naphtha would appear to be the best suited. No wonder that the Indian fertiliser industry has so far shown a marked perference for naphtha as a feedstock and all plants commissioned since 1967 to date were naphtha based till now

Table 5 : Fertiliser Plants According to Process Adopted

Plant	Per cent capacity utilisation				
	1969-70	1970-71	1971-72	1972-73	1973-74
(a) Partial oxidation process					
1. FACT, Alwaye	44	33	40	35	44
2. EID-Parry, Ennore	60	54	69	73	65
3. FCI, Gorakhpur	91	85	95	83	80
4. FCI, Trombay	49	78	85	75	69
(b) Steam reforming process					
5. FCI, Namrup	56	60	66	75	80
6 GSFC, Baroda	51	68	86	94	75
7. CFL, Vizag	85	94	81	74	68
8. SCI, Kota	72	102	98	116	100
9. IEL, Kanpur	9	54	64	80	57
10. MFL, Madras	—	—	22	64	76
11. ZACL, Goa	—	--	—	—	45
12. FACT, Cochin	—	—	—	—	9
13. FCI, Durgaur	—	—	—	—	3
(c) Miscellaneous process					
14. FCI, Sindri	63	63	49	62	63
15. NCJM, Varanasi	30	59	46	35	40
16. HSL, Rourkela	25	20	39	40	38
17. FCI, Nangal	100	69	71	87	77
18 NLC, Neyveli	61	46	28	30	21

Ref : Fertiliser Statistics, FAI, 1968-69 to 1972-73.

when the changes in the international oil scene have forced us to opt for alternatives like fuel oil and coal.

According to Process Adopted

The units and their productivity reclassified under the various processes adopted like partial oxidation, steam reforming and miscellaneous processes are shown in Table 5. The plants based on steam reforming of naphtha appear to have performed the best of the lot. For example,

the overall average performance of the plants at Baroda, Visakhapatnam, Kota and Kanpur at 91 per cent during 1972-73 is commendable. The average productivity of the plants based on partial oxidation process barring FACT, i.e, Ennore, Gorakhpur, and Trombay at 76 per cent is also fairly satisfactory. Other units using miscellaneous processes have not fared as well. To sum up, plants using steam reforming process of naphtha have performed much better than those using other processes.

The lesson here is obvious. For a country like India with limited resources and which has to rapidly augment domestic production to meet the ever increasing demand, we must adopt proven, even though less sophisticated, technology and equipment.

Table 6 : Fertiliser Plants According to Product-mix

Plant	Product	Per cent capacity utilisation for N				
		1969-70	1970-71	1971-72	1972-73	1973-74
(A) Units having single product						
1. NCJM, Varanasi	AC	30	59	46	35	40
2. FCI, Nangal	CAN	100	69	71	67	77
3. HSL, Rourkela	CAN	25	20	39	40	38
4. NLC, Neyveli	U	61	46	28	30	21
5. FCI, Gorakhpur	U	91	85	95	83	80
6. SCI, Kota	U	72	102	98	116	100
7. IEL, Kanpur	U	99	54	64	80	57
8. ZACL, Goa	U	—	—	—	—	45
9. FACT, Cochin	U	—	—	—	—	9
10. FCI, Durgapur	U	—	—	—	—	3
(B) Units having multi products						
11. FACT, Alwaye	AS, APS, AC	43	33	40	35	44
12. FCI, Sindri	AS, ASN, U	63	63	49	62	63
13. EID-Parry, Ennore	AS, APS	60	54	69	73	65
14. FCI, Trombay	U, NP	49	78	85	75	69
15. FCI, Namrup	AS, U	56	60	66	75	80
16. GSFC, Baroda	AS, U, DAP	51	68	86	94	75
17. CFL, Vizag	U, UAP	85	94	81	74	68
18. MFL, Madras	U, NPK	—	—	22	64	76

Ref : *Fertiliser Statistics*, FAI, 1968-69 to 1972-73.

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According to Product Mix

The data for the 18 plants has been reclassified in Table 6 into two categories according to the product mix of the plant, namely, single and multiple product producers. Although no conclusions can be clearly drawn, it appears, by and large, units producing single product have had a better capacity utilisation than those producing more than one product. Even amongst the units producing single product, the performance of urea producing units, with the exception of Neyveli, is better than those producing other products. The overall average performance of units at Gorakhpur, Kota aud Kanpur during 1972-73 works out to 93 per cent, which is very good indeed. This seems to corroborate the findings in many other industries that a "Focus Factory", i.e., a factory which focuses attention on only one product, tends to have a much higher level of productivity than plants which cater to a variety of needs.

According to Importance of Fertiliser Output Relative to its Overall Operations

There are two plants, where the main activity is not fertiliser. At Rourkela, the main product is steel ; at Neyveli, the main activity is power generation and briquetting. As such, fertiliser manufacture did not attract as much attention as it should ; however, due to the high priority given to the industry, the situation is now changing for the better.

At Rourkela, coke oven gas, which along with naphtha is the feedstock for the fertiliser plant has two alternative uses—for firing the furnaces in the steel plant and as a feedstock for fertiliser manufacture. Steel production gets a priority thereby impeding fertiliser production. Similarly at Neyveli, fertiliser production suffers due to higher priority given for power generation. This explains the reason for low capacity utilisation at 35 per cent and 29 per cent for 1972-73 and 1973-74 (Table 7) as against the national average of 70 and 54 per cent for corresponding years.

According to Plants Having Power Units

Five plants have captive power plants, i.e. Sindri, Neyveli, Kota, Goa and

Table 7 : Plants Having Fertiliser Production as Secondary Activity

Plant	Per cent capacity utilisation for N					Main Activity
	1969-70	1970-71	1971-72	1972-73	1973-74	
1. HSL Rourkela	25	20	39	40	38	Steel production
2. NLC, Neyveli	61	46	28	30	21	Power production

Cochin (Table 8). The performance of Kota plant is good. Goa and Cochin plants have not stabilised in production. The production of Sindri and Neyveli is not satisfactory for reasons other than power. In all these plants, production loss due to power failure or voltage dips is nil.

It will thus be seen that an objective assessment of capacity utilisation is a complex task. It is a function of many variables over many of which management may have no control. The foregoing analysis does, however, point to the fact that by and large modern plants with a large capacity using naphtha as feedstock and adopting steam reforming process and producing a single product, preferably urea and owning a power plant tend to perform very well.

Table 8 : Plants Having Captive Power Units

Plant	Per cent capacity utilisation for N				
	1969-70	1970-71	1971-72	1972-73	1973-74
1. FCI, Sindri	63	63	49	62	63
2. NLC, Neyveli	61	46	28	30	21
3. SCI, Kota	72	102	98	116	100
4. ZACL, Goa	—	—	—	—	45
5. FACT, Cochin	—	—	—	—	9

International Comparison

Plantwise capacity utilisation : The performance of various units in India has been with similar plants in other parts of the world. Enough relevant data is, unfortunately, not available. However, capacity utilisation for some countries having one or two plants is available for 1972-73 and is given in Table 9. It may be noticed that the productivity in these countries varies from 3 to 119 per cent ; the average works out to about 50 per cent which is much lower than the overall average productivity in India.

Productwise capacity utilisation : Limited information is available of the capacity and production of a few fertilisers like ammonium sulphate, urea, single superphosphate, triple superphosphate and DAP for North America, Mexico and Japan. Comparable data for these five products or India, North America, Mexico and Japan are given in Table 10.

It may be seen that the capacity utilisation for ammonium sulphate is comparable with that of Japan which manufactures a large tonnage of the product inclusive of by-product. The productivity in USA and Canada is much higher, partly because it is obtained as a by-product of the caprolactam industry.

The productivity of urea in India has been generally lower than the other countries during the earlier years which were really formative years for the industry. The performance during 1972-73, which was the best year for India, appeared to be very satisfactory compared with the performance in other countries. Capacity utilisation suffered a severe setback in 1973-74 due to power cuts and coming on stream of three units (Goa, Cochin and Durgapur) where production had not yet stabilised.

The performance of single superphosphate of domestic units is comparable with those in USA, Canada and Japan. In Mexico, the productivity is much better. In the case of DAP, the productivity in India is considerably poorer compared to that in USA and Canada.

Overall capacity utilisation of N & P_2O_5 : Unlike plantwise data for N, enough uptodate information is available of nitrogen capacity and production for some developed and developing countries and

Table 9 : Some of the Individual Plants in Other Countries

	Plant	*Per cent capacity utilisation in* 1972-73
1.	**Austria :** Oesterreichische Sticktoffwerke AG	43
2.	**Switzerland :** Emserwerke AG	
3.	Lonza AG	90
4.	**Finland :** Kemira Oy, Oulu	119
5.	**Albania :** Location : Vlone	88
6.	**Iran :** Iranian Fertilizer Co. Shiraz	
7.	Shapur Chem. Co. Bander-e-Shapur	36
8.	**Iraq :** Government Plant, Basra	31
9.	**Israel :** Chemical & Phos., Haifa	36
10.	**Kuwait :** Kuwait Chem. Fert. Co., Shuaiba	
11.	Kuwait Petrochemical Ind. Co., Shuaiba	46
12.	**Burma :** National Fert. Co., Sale	
13.	National Fert. Co., Pagan	76
14.	**Indonesia :** Petrokimia, Gresik	
15.	P.T. Pupuk Sriutdgaja, Folem bung	21
16.	**Philippines :** Meria Christina Fert. Corpn., Iligon	47
17.	Planters Products, Limay	
18.	**Malaysia :** Esso Standard Malayesia Ltd., Port Dickson	98
19.	**Thailand :** Chem. Fert. Co. Ltd., Mae Moh	30
20.	**Algeria :** Sonatrach, Arzew	18
21.	**Rhodesia :** Sabla Chem. Ind., Que Que	65
22.	**Cuba :** Cienfueges Plant, Cienfueges	
23.	Raul Cepero Bonilla, Matanzas	5
24.	**Trinidad :** Federation Chem. Ltd., Point Lisas	62
25.	**Colombia :** Amoniaco del Caribe SA, Cartagena	53
26.	Fertilizantes Colombians, Barrancabarmeja	
27.	**Peru :** Cuzco Corpn., Cachimay	77
28.	Fertilizantes Sinteticos, Callo	
29.	**Venezuela :** Instituto Venzeolano de petroquimica (IVP), Puerto Moron	3
	Average	50

Remark : The countries noted here have only those plants which have shown against each of them.

Ref. 1. *World Fertilizer Atlas.* 4th Edition, Brit. Sulphur Corpn. Ltd., 1973.

2. *Monthly Bulletin of Agr. Econ. & Stat.*, FAO, 23(3), 19-22 (March 1974).

Table 10 Productwise Performance in Some Selected Countries

Particulars	India—April-March					USA+Canada Jan.-Dec.					Mexico			Japan March-April
	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74	1971	1972	1973	1968	1969	1970	1971	1972-73
Ammonium sulphate	58	59	62	59	59	60	99	99	90	69	88	81	71	57
Urea	36	69	71	70	81	51	—	86	82	73	85	81	84	86
Single super-phosphate	51	47	46	57	63	56	45	50	58	81	91	84	88	22
Triple or concentrated superphosphate	15	28	21	29	18	11	85	80	83	—	—	—	—	—
Di-ammonium phosphate	51	41	51	47	64	56	83	86	89	—	—	—	—	—

Ref : 1. *Fertiliser Statistics* 1968-69 to 1972-73 (For India).
2. W. F. R., January, February 1972; April 1972; November 1972; June 1973; October 1973; March 1974 (For USA).
3. W. F. R., July 1972 to June 1973 (For Japan).
4. W. F. R., October 1971; August 1972 (For Mexico).

some regions. The productivity worked out from this data is presented in Table 11. It will be seen that by and large, the overall performance of the industry in India with respect to nitrogen is comparable both with the developing and developed countries. During 1972, productivity in India was the highest in the world except for 'Other Asia', and higher than the world average—a very gratifying situation indeed.

A similar analysis for P_2O_5 has not been feasible due to lack of recent data. Latest published information is presented in Table 12. It is apparent that the performance in India was uniformly lower than that of the developed countries primarily due to the dependence on imported raw materials and spares. But such a conclusion will not probably be valid any longer as many steps have been recently introduced to improve the productivity of various units in India.

Capacity utilisation of ammonia plants : The American Institute of Chemical Engineers has recently conducted a surey of ammonia plants with a view to finding out the reasons for their downtime. A total of 27 plants participated in the survey : 8 of 600 tpd, 3 of 750 tpd, 13 of 1000 tpd, and 3 of 1500 tpd. These facilities represented 75 per cent of the large tonnage ammonia plants in North America. The survey covers the two-year period 1971-72 and updates the 1969-70 survey of 22 plants presented in 1971. Comparison of performances for older and newer plants revealed the following :

	1969-70 Survey	1971-72 Survey
Pre 1968 plants Days of downtime	54	47.5
1968-71 plants Days of downtime	40.5	40.5

These figures are averaged from the following details :

Downtime	*Number of plants*		
Days	*Pre-1968*	*1968-71*	*Total*
10	1	0	1
20	1	1	2
30	3	4	7
40	3	1	4
50	3	2	5
60	4	0	4
70	1	0	1
80	1	0	1
90	1	1	2
Average	47.5	40 5	
Total :	—	—	27

It will be seen that of the 18 older plants as many as 7 had a downtime of 90 days and over against 1 of the newer plants. American and Indian experience is thus identical that older the plant, higher the downtime.

It is also interesting to observe that even some of the modern plants in an advanced country like USA based on a simple raw material like natural gas, had not worked for 80-90 days per year. Furthermore, only 4 out of 18, i.e., 22 per cent of older plants and 5 out of 9, i.e., 56 per cent of the newer plants were able to achieve the national ideal in the chemical industry of 350 stream days.

Table 11
Total Nitrogen Capacity Utilisation in Some Selected Regions of the World

Region	*Per cent capacity utilisation*					
	1967	1968	1969	1970	1971	1972
India*	55	61	53	63	62	70
North America	52	59	58	61	65	66
West Europe	68	69	68	58	56	55
East Europe & USSR	63	69	66	68	69	65
Japan	86	93	96	62	52	43
Israel	76	79	85	91	40	47
South Africa	33	24	38	54	53	49
Oceania	16	20	26	43	43	59
Latin America	57	48	46	47	50	47
Developing Africa	124	115	36	27	34	35
Developing Asia	26	40	51	50	34	43
Other Asia	48	51	54	59	69	88
World	59	63	63	60	61	60

* Figures are on April-March basis.
Ref : *World Fertilizer Market Review and Outlook,* TVA, 1974; p 41, 43.

The Survey has divided main causes for shutdowns and their associated downtime into five classifications, i.e., instrument failures, electrical failures, major equipment failures, turnaround and others. Major equipment failures accounted for 6 out of 18 shutdowns reported for the pre-1968 plants, and 5 out of 9 for 1968-71 plants. Also major equipment failures accounted for 21.5 days downtime, out of the average of 47.5 days for pre-1968 plants and 16.5 days out of 40.5 days in 1968-71 plants. The main reasons for shutdowns of the plants, with the resulting downtime are, therefore, obvious.

The failures in the major equipment were analysed as follows :

	Pre-1968 Plants	*1968-71 Plants*
Primary reforming	8	2,5
Secondary reforming	2.5	2
Purification	2.5	2.5
Syn loop & refrigeration	0.5	5
Major compressors and turbines	7.5	4
Miscellaneous	0.5	0.5
TOTAL :	21.5	16.5

It may be seen that among the major equipment failures, primary reformers, compressors and turbines account for a major part of the downtime. In the primary reforming section, tube leaks, riser leaks and manifold leaks caused the most shutdowns. Amongst compressors and turbines, air compressors and syn gas compressors were the main source of trouble. An examination of the causes of failures in Indian fertiliser plants also is likely to present a similar picture.

Performance of Indian Fertiliser Industry without any External Constraints

Production performance of the fertiliser industry during 1972-73 and 1973-74 shows that the productivity is much lower during 1973-74 compared to the previous year. Reasons for this deterioration have been analysed by many competent authorities including the FAI. There is a fair amount of agreement between their findings. Power failure and voltage and frequency dips, shortage of imported spares, labour unrest and inadequacy of raw materials, have been identified as the main contributing causes.

Of these, power cuts and tripping frequency and voltage variations which are a common phenomenon throughout the country, are the major source of worry particularly because no short-term solution seems to be in sight. Moreover, these are external constraints over which the

Table : 12 N & P_2O_5 Capacity Utilisation in Some Selected Regions of the World

Region	*Per cent capacity utilisation*					
	1965		1966		1967	
	N	P_2O_5	*N*	P_2O_5	*N*	P_2O_5
India*	72	63	59	52	55	62
North America	82	78	64	76	62	74
Western Europe	77	87	83	82	74	83
Eastern Europe	81	85	92	63	87	77
Asia (Less Japan)	62	74	63	65	71	60
Oceania and Japan	95	85	86	71	87	71
Africa	67	59	66	54	56	52
Latin America	44	60	56	48	60	51

*Figures are on April-March basis.

Ref : Estimated World Fertilizer Production Capacity as Related to Future Needs 1967 to 1972-80; TVA June 1968; p 18-21.

industry has no control and yet they vitally affect the production performance of the industry. Units like Nangal, Gorakhpur, and Kanpur, have produced and are capable of producing well upto 100 per cent of their capacity whenever sufficient power is made available to these plants. During 1973-74, these units averaged at only 67 per cent of their capacity. Production loss in these units alone during the year was 120,000 tonnes, which at current prices would cost $100 million to import. A possible solution would be the setting up of Integrated captive power plants for each large-size existing and prospcetive fertiliser plant. This would also lead to a better fuel effciency.

Rourkela and Neyveli plants suffer from a chronic shortage of raw materials, i.e., coke-oven gas and lignite which impede capacity utilisation. Availability of adequate raw materials, a matter out of control of the fertiliser industry as such, can considerably boost production from these units.

Conclusions

In both, Rourkela and Neyveli plants, fertiliser production is a subsidiary

activity in the whole complex. If there is a competing demand for the available quantity of intermediate or raw material between the major activity and the subsidiary, the former must naturally get precedence. This is precisely what happens in these units. In any study of the fertiliser capacity utilisation, the performance of these units must be excluded. On this basis, capacity utilisation of nitrogenous units in India during 1972-73 and 1973-74 will be, excluding the Rourkela and Neyveli plants, 77 per cent and 57 per cent respectively. When these two plants are included then the capacity utilisation is 70 per cent for 1972-73 and 54 per cent for 1973-74.

There is acute shortage of power in the country and there are many urgent competing demands. Central and State Governments have, perforce, to allocate priorities and an individual unit or industry can do nothing more than representing its case. To judge the performance of the industry any loss of production due to this factor, on which the industry just has no control, should be excluded. If the actual loss of production on account of power cuts in even three plants, i.e., Nangal, Kanpur and Gorakhpur, is taken account of for the year 1972-73 and 1973-74, the capacity utilisation for all units excluding Rourkela and Neyveli will be 83 per cent and 63 per cent respectively.

The foregoing analysis that despite the handicaps and constraints the fertiliser industry in India compares favourably with its counterparts elsewhere, developed countries included. Indeed, some of the domestic plants equal the best in the world. Barring a few old plants, the rest of the plants can produce upto their maximum installed capacity if external constraints like power, raw materials and spare parts were removed.

Readers' Page

I read with interest S. Venu's paper "Technological Innovation and Productivity" : A Reassessment, "PRODUCTIVITY Vol. XV No. 3 Oct.-Dec. 1974. It is surprising to note that the material for this paper has been borrowed and at some places copied verbatim from a much more comprehensive and interesting paper "The impact of Technological Innovation— Concepts & Measurement" by Bela Gold in OMEGA, Vol. 1, No. 2, April 1973. Generally, when you borrow an idea from a different paper, you acknowledge that paper, but Mr. Venu in his paper has not even quoted Bela Gold as a reference. He could have still justified his paper had he given a comparison of different schools of thought on the effect of technological innovation on productivity and which one is more acceptable under different sets of conditions, or he could have applied the approach given by Bela Gold to some industry to segregate the effect of technological innovation from Labour Productivity.

—N.S. Josan,
Bokaro Steel Limited,
Bihar.

Book Reviews

Agricultural Development in India : A New Strategy in Management

P.V. Shenoi

Vikas Publishing House Pvt. Ltd., 1975, pp xlv+373. Price Rs 55/-

Reviewed by Prem Lal*

To bring a stagnant agriculture into motion requires both perception and operationality in approach. If one is to suggest a general strategy equally applicable to any of the underdeveloped countries of the world (though valid theoretically), one may at best hit at the outlines of an effective operational strategy. This seems to be true regarding the book under review.

It is divided into four parts : Part I dealing with the planning aspects of agriculture. Parts II & III deal with the institutional factors (like extension and training services, agricultural, marketing, soil conservation and land reforms etc.) and with the input availability (like seeds, fertiliser, irrigation etc.). The last part tries to synthesis all these in order to have an efficient management in agriculture.

In case one is looking for detailed descriptions and data regarding the inputs availability and regarding the organisation for the extension of modern agriculture practices, one may be quite satisfied with the coverage of the book. The book points out a number of imaginative proposals also. But their use in actual situations is very doubtful, as the preconditions for their operationality hardly exist in India.

The way the author goes about suggesting improved management of agricultural planning, at its different levels, gives one an impression that this sector of the economy lives and thrives in isolation. In fact, it is the overall rate of growth of the economy, the share in and the nature of investment for agriculture, the amount of complementarity and competitiveness between the agricultural and industrial sectors, which

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determine agricultural growth. It is not only the market mechanism, the price incentives and availability of inputs which always lead to increased productivity and production. This type of approach presupposes the existence of favourable conditions on the side of innovative willingness and ability. In fact, the pre-conditions have to be created for an effective response on the side of receivers of these benefits, which is not strictly a function of price-incentive and of availability of inputs. Since human factors happen to dominate both at the giving and receiving ends of any management activity, it becomes, therefore, necessary that the management of social and institutional conditions be improved prior to the launching of any successful material factors. Though the author seems to recognise this fact, unfortunately, he has not been able to keep up the priority and at many places he seems to have run into contradictory statements. For example, while recognising the importance of cultural, distributional and institutional factors, he goes on to say "the profitable innovations are accepted by farmers despite imperfections in land tenure, marketing and other inputs". Further, while recognising the plight of the poor farmers, he goes on to make the statement "if prices are low, the poorer farmers have to sell more of their output to satisfy the need of cash, which pushes prices further down", ignoring both the facts, that these are the very persons who are victims of the phenomenon of distress sale and that at the given level of their output they hardly have any margin of surplus in their existing consumption level. Further, according to him, "the farmer is the looser", but he fails to pinpoint the class within the farmer category who, in fact, are the victims. In this context, he also fails to point out the way the 'support prices' have been utilised by the rich farmers and middlemen for their advantage.

According to him "a major policy issue is how to raise the incomes of the rural poor small farmers and also landless labourers ..", as, according to him, rural poor have not been benefitted by the fruits of economic development in India. On the other hand, one fails to locate any built-in mechanism by which such 'fruits' may filter down to this class if one follows his approach of management of agriculture.

On the whole, the book is an enjoyable reading. It is lucidly written and is likely to be useful for those looking for the analysis of agriculture management from the same point of view which the author maintains.

Land Development Banking in India

Dr. B. S. Mathur

National Publishing House, Delhi, pp 315, 1974

Reviewed by N. C. Saxena*

In this book a successful attempt has been made to summarise various aspects of long term credit and working of land development banks in India. Chronologically, the first land mortgage bank was established in 1863. This was incorporated in London and it closed down in 1885. A real beginning in this direction was made in 1920 when the first bank was set up in co-operative sector in Punjab. Initially the expansion was very slow and the banks confined their activities to provide loans for redemption of debts mainly. The main beneficiaries were big land owners and agricultural credit societies. After independence, however, there was a rapid expansion in the number of banks and their activities. This was necessitated by the massive effort to increaes agricultural production on the one hand and enforcement of different kinds of land reform measures on the other. Various expert committees, after thorough investigations, recommended setting up of a central land mortgage bank in each State and an economically viable primary unit at taluka level or below, and an apex body of federal character comprising of central land mortgage banks at top. The existing structure of the banks is not uniform throughout the country both at state level and below. While federal system is prevalent in many states, few states are operating on unitary system. Former is considered a better system and has been recommended by various expert committees also. To strengthen the working of long term credit, it is essential to have a uniform pattern throughout the country. There are vast differences in the unit area under operation of banks in different states. It appears that there is no rational pattern to decide about it. Quite often the criteria of economically viable unit is not adhered to. It could have been an interesting exercise to study this aspect in an analytical manner.

Till recently, the land development banks were managing their finance through borrowings, loans and grants, etc., from various sources. In few cases floating of debentures was also undertaken for raising the

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funds. In the wake of an increasing emphasis on interim finance the banks have now streamlined their sources of finance. Share capital is one such major source. Besides deposits, floating of debentures and borrowings from central banks are other sources of finance. The share capital is contributed by members of a unit and a minimum is necessary for becoming a member. (This excludes the admission fee charged). Besides, some proportion is contributed further in case any loan is taken by a member. There is no uniform pattern for this deduction and it varies from 2 percent to as high as 15 percent from one place to another. Apart from individual members the institutions and in many cases Government also contribute to the share capital. Government participation has been of a high magnitude in few cases. In some cases, a minimum of 51 percent shares are subscribed by the Government. In the spirit of co-operation, it is desired that the Government participation should be very low. Commercial banks who, of late, have entered in the arena of long term agricultural credit, do not ask for any contribution towards share capital or so. And these financially strong institutions would presumably perform better.

In the third five year plan there was an unprecedented demand for long-term credit for increasing irrigation potential, adoption of new production techniques and different kinds of land improvements. Accordingly, the banks began to re-orient their loaning policies for productive purposes and agricultural development. Not only this but certain other factors like the guarantee by RBI and conditional investment in their debentures by LIC and agicultural finance corporation, etc. necessitated that 90 percent of loans advanced, should be for productive purposes. Of this, 70 percent should be for definite identifiable purposes. All land development banks accepted this in principle and practice. There is, however, no uniformity in the quantum and duration of loans for identical purposes and interest rates charged thereon, among various land development banks. It will be desirable to have standard norms for different areas, which may be reviewed at a specific interval. Earlier, the quantum of loan was decided on the basis of security and land valuation. This has changed and now the repaying capacity is calculated by taking into account the incremental income likely to be generated by the proposed investment. But the repaying capacity shall still be different for small, medium and large farmers ; and this should be a guideline to decide the duration of the loan. Another aspect of loan operations is mounting overdues.

It can be attributed to irrational loaning coupled with no or little supervision of the loans. A vigilant supervision, even if it adds up a little financial burden, is of high importance and shall prove a deterrent factor to keep the overdues down. Various measures suggested in the book are not exhaustive and many more can be adopted according to specific situations. Further, coordination at various official and non-official levels will cut down the prolonged waiting for sanction of loans. Some survey results presented in the book reveal that normally it takes 3 to 6 months for a loan disbursement after the application has been made. The author has dealt in detail various coordination measures suggested by Reserve Bank and other expert committees, but these are seldom adhered to. Often the failure of cooperative movement is attributed to weak and inefficient management and laxity in administration. No proper attention has ever been paid to good and efficient management. Further, the guidelines provided and rules laid down are often flouted at will by the persons, with vested interests, controlling the affairs of co-operative institutions, including land development banks

Agricultural Refinance Corporation was established to provide finance through eligble institutions for such schemes/projects needing heavy investments. Other existing credit agencies were not able to finance these schemes/projects owing to heavy outlays. Reviewing a decade's performance, it is found, that so far, the Corporation has financed 450 schemes with a total outlay of Rs. 300 crores. Of this, 420 schemes were related to land improvements, irrigation and plantations. It has been observed that the corporation schemes receive a low priority at the level of land development banks. Further, most of the schemes are formulated without proper detailed technical feasibility surveys. Nonetheless, procedural delays, inadequate staff and heavy paperwork have adversely affected the progress of corporation-schemes. An initial delay on account of detailed analysis of the scheme at formulation stage can be of great help at the time of execution and afterwards.

Although long term credit in absolute terms has expanded tremendously, it covers only about 40 percent of total long term credit needs of agriculture. Further, the farmers benefited by the land development banks are only a fraction of the total. The book makes a good reading of long term credit and by its nature it can serve as a good textbook on the subject of agricultural finance.

Science, Technology and Economic Development

A. Rahman

National Publishing House, Delhi, 1974. pp. 228, Price Rs. 37.50

Reviewed by S. M. Pandey*

Evolution of an effective and viable science policy aimed at integrating science and technology with ever-changing needs of the society, more so of a developing one, has to be a continuous process. An understanding of the dynamics of this evolutionary process should be helpful in providing a clearer perception of the policy in terms of its direction, strength, and weaknesses. The present book by Abdul Rahman, which consists of seven papers prepared by him for various journals and seminars, aims at providing such an understanding.

The first two chapters deal with the nature and problems of science policy in India. The author discusses, in a readable language, the following aspects of science policy in India : surveys and studies for evolving science policy, the organisation and planning of science and technology, national budgeting of science, implementing agencies, coordination and evaluation of research and international collaboration. The author concludes that in India the process of transformation of scientific research from the level of individual effort to the level of industry is in a preliminary stage. As a result, the necessary framework for research in terms of national policy, planning and coordination of resources, and necessary machinery for implementation, review and evaluation are still to be fully developed. The author appreciates the fact that India has made considerable investment in scientific and technological research, has built up an extensive machinery for research and has created enough potential.

It is heartening to know that for every 12 scientific discoveries made in U.S.A., one is made in India. However, this potential can be fully exploited only when the above-mentioned transformation takes place. He outlines steps which are needed to achieve this. However, he argues

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against any institutional arrangement that may lead to excessive centralisation which can sultify scientific and technological research. He suggests that greater emphasis must be laid on properly coordinating the existing machinery, participation of the scientific community at various decision-making levels with more efficient channels of communications etc. By virtue of his/her training and professional outlook, a scientist would like to actively participate in the fields of the organisation and management of science. He/she would like the broad policies, contemplated organizational reforms and other decisions to be widely discussed so that he/she could subject them to objective criticism, participate in the process of arriving at a consensus and thus develop a commitment to the decisions. If this participation is denied to a scientist, as happens in many cases, through social or management constraints, he/she may become overcritical or totally indifferent to broad issues and not develop any commitment to the overall programmes. It hardly matters whether they fail or succeed as the scientist does not feel a party to them. The personal career with the establishment then becomes the sole concern without questioning the bonafides of the decisions. Often, a scientist is frustrated when he/she is forced to accept an obviously wrong decision, finds serious flaws in it but is totally helpless to modify or change the decision. Can a developing economy like ours, having severe resource constraints, afford this ? Should we continue to exclude scientists from the decision making process at the cost of those who are only remotely connected with the subject and have little appreciation of the matter ?

The scientists are categorised by the author in three broad categories : (i) those who work and continue to be productive, (ii) those who are not productive by themselves but tag themselves on to creative workers; (iii) those who are burnt out and adopt other means than scientific research to continue in the fields, including those who become advisers, consultants, professional committee men etc. The health of science in any country depends upon a balance between the three categories. A larger proportion of scientists in the last two categories can create an unhealthy climate and drive away young and creative workers who can make real contribution to science. This may promote discrete groups of professional committee men or decision makers who develop vested interest of their own, leading to tremendous concentration of power.

Consequently, a sharp line is drawn between senior (burnt out) scientists who play musical chairs in positions of power and the younger ones who

continue to mark time, hoping to go up one day, mostly through "adjustment" with seniors rather than through distinctive research. The control of the management of science also discourages young scientists to have continuing commitment to the scientific needs of Indian society. Rather they tend to believe in the internationalism of science.

The book also contains interesting works on the impact of economic support and policy on scientists in the light of historical and social development; financing of scientific and technological research in India; science, technology and industrial growth; research and development in Indian pharmaceutical industry; and managements' attitude towards research and development in iron and steel industry.

The conclusions and policy implications emanating from the book need serious attention of the government in the interest of the country.

Economic Theory and Policy : Essays in Honour of A. K. Das Gupta

Edited by Ashok Mitra

Oxford University Press, Calcutta, 1974, pp xvi+326, Rs. 50.00

Reviewed by V.S. Mahajan*

The book under review is in honour of Professor A.K. Das Gupta for his sustained and qualitative contributions to the field of Economic Theory during the last 4 or 5 decades. Released on his seventieth birthday, it carries articles by reputed economists like, J.R. Hicks, Mrs Joan Robinson, A. Sen, R.M. Goodwin, J.E. Meade and others. Contributions from such eminent economists show that Dr. Das Gupta is held in high esteem.

Part I of the book carries a dozen papers on economic theory and includes subjects like "Preference and Welfare" (J R Hicks), "On Some Debates in Capital Theory" (Amartya Sen), "The Abdication of Neo-

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classical Economics" (Mrs Joan Robinson), "On Optimum Population Size" (Partha Das Gupta), "The Principal Modes of Production of Karl Marx" (Daniel Thorner) and others. Most of the articles included in Part I would be found extremely refreshing for those looking for recent development in economic theory.

Part II of the book, which is devoted to planning, would be of interest to those who are not well versed in economic theory. Though this part is distributed over 11 papers, article of particular interest is by Louis Leferber on "the Paradigm of Economic Development". Here he argues how the western models of Economic Development are unsuitable for developing economies and they have much to learn from the recent experience of communist countries. Lefeber is full of praise, in particular, for the Chinese experiment. "China is the only overpopulated and under-developed country which seems to have solved the problem of introducing and maintaining minimum living standards for the population at large ..... And whatever, if any, disincentive effects of the communal land organisation on individual effort, it has shown that it is an effective means for decentralised planning and for implementing broad social and economic policies. It could locally redistribute income and, at the same time, generate savings or food surpluses for maintaining labour engaged in rural capital information", (p 175). India will have to learn some lessons from the Chinese experience and do something to stop the large-scale exodus of rural population to urban areas by providing worthwhile (or productive) employment opportunities in the rural areas. If China can contain inflation with its 800 million mouths to feed, there is no reason why India with far less population should not do something to check inflation.

However, A. Vaidyanathan's article "On the New Economics of Poverty" is pessimistic of the labour-intensive modes of production. He says that "a greater emphasis on rural development seems unlikely to make a significant and early impact on income distribution". (p 225). He is for the modern economic growth (persumably, by adopting the latest modes of production which one would have expected him to spell out), and adds that growth and distribution are not competitive but complementary. Perhaps, Vaidyanathan is hoping too much when he suggests that modern industrialisation would provide solution to the economic malaise facing the country. He might change his views after reading Leferber's article.

Dantwala and Pravin Visaria have contributed a well-documented article on "Rural Labour Force and Employment Policy". They say that "between 1971-82, about 58 million persons would be added to the labour force in India.

If we add to this 22 million persons estimated by Raj Krishna as either working unemployed or available for work, 80 million persons would have to be provided with additional or better job opportunities .." (pp 253-54). Considering the present rate of growth of the economy it appears difficult to take care of even half the people thus estimated. I.S. Gulati contributes article on "Tax Policy for Promoting Employment". This has relevance to the conclusions arrived at by Dantwala as well as by Vaidyanathan, i.e., the use of appropriate fiscal measure would go a long way in promoting employment in the country as well as ensuring distribution of income. D.T. Lakdawala in his article "Fiscal Policy in India" highlights the failure of administration in adopting dynamic fiscal policy. He raps the Government for placing undue reliance on controls which have been *"Our weakest spots"*. K.N. Raj contributes an article on "Monetary Management and Nationalization of Banking in India".

He exposes the weak spots of the nationalized banks and, in particular, emphasises that despite the growth of rural banking, after nationalisation, no worthwhile purpose has been served either for mobilisation of resources or for their distribution among the rural population. He also adds that big customers of the bank (i.e. those operating large credit accounts) continue to dominate these banks, likewise they did before nationalisation; and this has been despite the "Credit Authorisation Scheme introduced in 1965 (and) modified in mid-1970, specifically to enable scheduled banks to undertake systematic credit appraisals" (p. 318).

The utility of this thought-provoking book would have been further enhanced if the editor had given appropriate summaries of the articles published. Also, the price of the book by Indian standards appears to be on the higher side. The book, on the whole, is extremely stimulating, and policy-makers and students in particular, and general readers, would benefit from reading it.

Models for Spatial Agricultural Development Planning

Fahmi K. Bishoy
Centre for Development Planning, Nether Lands School of Economics, Erasmous University, Rotterdam, 1974, pages 172

Reviewed By Hardip Singh*

The need to introduce the element of space in Agricultural Development Planning models arises on the three counts, i.e.,

(i) under the influence of varying physio-climatic condition, the same agricultural product can have different production functions in different regions.

(ii) the transportation costs of most agricultural products being relatively high may, drastically influence the optimum composition of agricultural production in different locations, and

(iii) interests of different regions on varying levels of development and with different development potentials may clash with each other.

The literature on spatial agricultural development planning with special reference to developing countries is miserably scarce. This study seeks to fill this gap. This work is based on the principles of the multi-sectoral and multiregional models presented by Menues, Tinbergen and Waardenburg (denoted as MTW models), with required reformulations to adopt these to the specific conditions of the agricultural planning problems. The model developed here tries to answer, within a national planning set up the following questions : Given the supply of scarce resources for the agricultural sector, some specified employment targets and aiming at the maximisation of agricultural production in the economy,

(a) what agricultural commodities should be produced, at what intensity and where ?

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(b) what are the optimum levels of agricultural exports and imports ?

(c) what are the optimum agricultural trade flows between different regions within the country ? and

(d) what are the optimum agricultural investment projects and where should they be carried out ?

The author has formulated two different sets of short and long run planning models. The basic characteristic of a SRA model in contrast with a LRA model is the assumption of fixed supply of sources during the short run for the agricultural sector. This distinction helps to identify clearly the crucial issues in planning the agriculture sector.

Chapter 4 presents the set of short-run models, where with the spatial allocation of resources for agricultural production the corresponding international and domestic agricultural trade flows. The numerical illustrations of these models demonstrating their viability follows in Chapter 5.

Chapter 6 offers the set of long-run models. Here the supply of some inputs can be increased by carrying out agricultural investment projects. Accordingly, the models aim not only at the determination of optimum spatial agricultural production plans, but also the determination of optimum agricultural investment schemes in different regions. This is again followed by a chapter with numerical specification to demonstrate their functioning.

In addition, there are three appendices brieflytreating, (i) the semi-input-output method and the present models ; (ii) two alternative formulations of the models together with a brief discussion of the possible existence of a relation between these formulations and decentralized agricultural planning, and (iii) the mathematical deriation of the investment function with 'gestation' lags used in some of the long-run-models

The scope of the model is limited to the extent that the issues such as the optimum form size and the increasing and/or decreasing marginal productivities, revenues and costs (i.e. the use of non-linear functions) have been left out of the analysis.

The study is a contribution to the formulation of models for planning the agricultural sector of a developing country like India. The author's knowledge of the technical and economic aspects of the sector adds in realism of the models formulated with great precision inventing and skill. Still, the models, as the author cautions, should be considered as frame-work models only. In other words, before these can be applied further refinements and extensions in accordance with practical experience are necessary if they are to comply with an actual situation.

New Books : Annotated List*

Business Planning and Forecasting

Jones Dennis Cooper

Business Books, London, 1974, pp 265, £ 5.00.

Deals with the fundamentals of business planning and forecasting, as illustrated by the problems and actions of an engineering company in planning its growth during the critical transition phase from a small specialised family business to a more expanding company. The book sets out to fulfil several different objects : to remind managers of some of the basic principles of operating a business; to establish guidelines and methods of planning; detailed review of all aspects of the day-to-day operations of the business; and to outline the present state of management science relating to forecasting and planning. The accent throughout is on common sense and simplicity, avoiding management gimmicks and jargons.

The Changing Profile of India's Industrial Economy

Biswanath Ghosh

The World Press P. Ltd., Calcutta, 1974, pp XIV+458, Rs. 22-00.

The present work is, within the compass of a readable volume, a thorough and analytic study of the labour and industrial situations in India. It gives the up-to-date facts and figures and depicts the new horizons of the industrial landscape of India in the context of the rapid changes that are being brought about under the Five Year Plans. However, it is not a mere record of facts and figures, it is a growth-oriented analysis of the Labour and Industrial Sectors of the Indian economy and offers important guidelines to thought and action. The author has kept an open mind throughout and has not hesitated to criticise wherever there is a deviation from the norm. The book should be in the hands of all those who are eager to get a clear picture and better view of the country's changing industrial front and its manifold problems.

* Prepared by Sri S. N. Vig, Documentation and Information Officer, National Productivity Council, New Delhi.

Computer in Production Management Decisions

T.A.J. Nicholson & R.D. Pullen

Pitman. London, 1974, pp. 178, £ 4.00

Production Managers or Systems and Computer Analysts would find this book extremely useful. Though it is not a text book, but it outlines the nature and use of computer programmes on a variety of production management problems. Distributed over 12 chapters, it tackles problems ranging from Orders and Capacity, Production Control, Systems Cost Benefit Analysis, to Product line Planning and Budgeting, Capacity Renewal etc. in a complex of plants.

India's Deepening Economic Crisis

B.M. Bhatia

S. Chand & Co., New Delhi, 1974, pp. V+215, Rs. 30.00

This book focusses its attention on India's current economic crisis. The variables which attribute to the crisis, such as galloping rise in prices, low rate of industrial growth, ever-increasing unemployment, labour problem, food problem etc., are dealt with in the book. Though these variables are studied separately with some historical background, by and large, they are inter-related and a dent in one has a direct impact on the other and the consequence is economic crisis.

Principles of Planned Maintenance

R.H. Clifton

Arnold, London, 1974, pp 230, £ 2.20

This book deals with work undertaken in order to keep or restore every facility, i.e. every part of a site, building and contents, to an acceptable standard. The book is not set out as a complete work of reference, nor does it provide a rigid system that can be applied universally to accomodate every situation; each maintenance system must be tailored to suit particular needs and conditions. Differing circumstances do not

change the principles, but differs only in the method of their application. An attempt has been made to express these principles in a simple, practical manner to enable the reader to obtain a clear understanding of the 'mechanics' of planned maintenance. The various components of a system can then be modified, assembled and adjusted to suit individual circumstances. Maintenance technicians, following the Objective Training Programme recommended by the Engineering Industry Training Board, will find the book particularly applicable, and most useful when studying the Maintenance Planning module of the course. Similarly, the Maintenance Organization and Maintenance Project content of the City and Guilds of London, Mechanical Engineering Technicians Course No. 255, Part II—Plant Maintenance and Works Services, Part III Plant Engineering, is amply covered by the text.

Productivity Through Consultancy in Small Industrial Enterprises

Asian Productivity Council

Asian Productivity Organization, Tokyo, p 503

The success of small business is vital to both developed and developing countries. One of the shortcomings of a small firm is the lack of training programmes for its managerial personnel, foremen and other supervisors. The Asian Productivity Organization presents this publication, designed as a useful tool to management trainers and consultants for small and medium enterprises in Asian countries. This book is a textbook to be used in management courses, not only in Asian and other developing countries, but in developed countries too, where studies are being made on the economic and productivity activities of developing nations.

Quantitative Methods in Economics

J.D.A. Cuddy

University Press, Rotterdam, 1974, pp 180

This monograph introduces economists to some of the quantitative methods with which they should be familiar in order to understand

modern empirical economic analysis. The book is not intended for those who wish to have a grasp of what econometrics is about and who may occasionally use econometric techniques. The book assumes that the student has had the usual first-year course in mathematical methods, especially the calculus and matrix algebra. But no familiarity with statistics is required. The book is accordingly, divided into two parts, of which the first presents an introduction to statistical inference, and the second an introduction to econometric theory and applications. The prose style is quite informal, and attempts to put across basic concepts only, rather than insisting upon highly rigorous standards of analysis.

Why the Japanese Have Been So Successful In Business ?

F. Fuerstenberg

Leviathan, London, 1974, pp. 107, £ 5

This book compares existing conditions of management in Japanese industries with those of Western European counterparts, and emphasises that efficient management in the former is tied to an altogether different cultural system of values. As such, the success of any economic system depends on these assumptions which are recognised and mutually agreed upon. Based on author's personal investigations carried out in large scale Japanese business enterprises, the book scans through the attitudes and the living conditions of the labour class. Divided into three parts, part one describes Japanese management from social, economic and historical view points. Part two deals with principles of management derived from empirical studies, while part three contains the individual investigation conducted by the author to enable the readers to understand the functioning of Japanese enterprises.

International Transfer of Technology : Myths and Facts*

Sumitra Chishti

The revolutionary advances in the field of technology have, while improving material conditions of human life, raised certain basic issues specially pertaining to the continued use of present type of technology for productive purposes. These questions range from the impact of technological advances on environment, resources conservation and capital-output ratios. It is feared in some quarters that present pattern of technological advances is not in a position to respond sufficiently to the changing ecological and other requirements. Further, the need to distinguish between real wants of human beings from those created by artificial means and their impact not only on resource utilization but also on creating a more desirable way of human life. The role of technology in this respect has been seriously debated. Hence, there is a growing body of opinion that technology should be made to respond to these new needs. The advance of technology should be regulated in such a way that it would answer many of these questions. One of the most important questions that is arising specially relevant to developing countries is the international transfer of technology, its implication to their growth process and its significance to sustenance of independence and cultural identity.

Why Transfer of Technology ?

The international transfer of technology had not been a subject of serious investigation for the decades and centuries. In fact, it had been primarily taking place among the advanced countries. The technology transfer problem did not bring about any conflict among these countries. This is mainly due to that most of the countries opted for a specific economic system, i.e., the private enterprise system and had achieved a comparable level of economic development, especially, industrialization.

* The views expressed in this article are those of the author and do not necessarily reflect the views of the Institute to which she belongs.

Culturally, there existed considerable homogenity. Although the strength of these factors in perpetuating the historical character of transfer of technology has been slowly eroded in the face of resource scarcity, pollution etc., they have not yet assumed large dimensions. The basic issue of international transfer of technology has been transfer of technology from developed to developing countries. This is indeed understandable, for the very basic features which have not necessitated a detailed investigation of implications of transfer of technology among advanced countries are missing in developing countries. After the attainment of political independence these countries are searching for a form of economic system which would not be necessarily a pure private enterprise oriented one. The search for new system has been forced on them most often by the structural difficulties of achieving economic growth. Second, inequality arising out of economic development between developed and developing countries has also brought in a large number of issues, such as advance terms of trade, transfer of resources from developing countries to developed countries. The factor endowment of these economies specially labour abundant has also made the indiscriminate international transfer of capital biased technology a questionable proposition. Finally, the life styles of developing countries are different from those of developed countries, despite the existence of a small section of the population imitating the western ways of living. Hence, the relevance, cost, mechanism and appropriate character of transfer of technology from advanced countries to developing countries are being examined.

Concept

Before analysing the issues of transfer of technology in this context, it is necessary to define the concept of transfer of technology At times, it is believed that transfer of technology is a gift from the seller to the buyer. Or, it is considered that by transferring a technology along with the capital, the seller is selling the technology to facilitate production with not much cost. This is distortion and a wrong interpretation. It has been established now that selling of technology is essentially a commercial proposition. It is sold with all the motivation that gives rise to a commercial transaction with one fundamental difference. The technology is being sold in an oligopolistic market. A few large multinational firms hold the technology as a powerful weapon of bargain.

In fact, it is believed that the strength of multinationals lies not so much in their technology but on this capacity to keep exclusive control over it.

In this transfer process, it is also believed that the developing and developed countries trade in technology with equal strength. Since sales of technology is purely a commercial transaction, the buyer is expected to play an equally powerful role as the seller. What is, however, overlooked is that the developing country as a buyer is a weak partner. The most important element in the purchase of technology is knowledge on the type of technology, its price etc. The developing country very often simply does not possess this required knowledge. Therefore, at the initial stage itself, the developing country starts with a great disadvantage of not having the power of bargaining. Superimposed on this, it has foreign exchange constraint. Thus, the bargaining on the basis of knowledge is one of the most important lacuna that the developing country has. To build up information on the basis of which it can effectively bargain specially with giant multinationals, therefore, should become the first policy objective of any developing country intending to purchase technology.

Myths and Facts

One of the important myths that is perpetuated and sustained by a deliberate policy of multinationals is the belief that they invest substantially in developmental research. As a result, they seek protection from all countries for their technology ownership. So patents are used as vehicles of monopoly protection. Thus, the research activity of the developing countries gets strangulated and does not get any initiative. In a survey conducted by the UN regarding the holders of patents in developing countries, it was found that as much as 95% of patents are held by foreigners in the developing countries.

Applying the same argument to them, the producing unit in a developing country either in the form of subsidiary or in the form of collaboration has to abide by certain considerations. These include a large number of restrictive clauses, and purchases of raw materials etc. from the parent body. The chemical and pharmaceutical industry of the world enjoys profits much beyond the necessary costs. In fact, many

fundamental breakthroughs in life-saving drugs had taken place in mid-sixties. Later, whatever additional research has been done has not basically changed the availability of such medicine. As a result, enjoying the exhorbitant price over their research findings for a long period has been one of the most important elements of costs in transfer of technology. In fact, the latest revelation on Indian drug prices wherein a foreign firm is importing basic raw materials from parent company 1,000 per cent more than the cost of production, 700 per cent over market price of other marketing countries is no exception. This has been the case in all the drug companies selling drugs to developing countries. Therefore, it is not essentially for technology that a developing country is paying; it is the perpetutation of monopoly rights of multinationals in technology which is being paid for by the developing countries.

Another difficult aspect of this transfer of technology is its inappropriateness. Very often, it is not appropriate in terms of meeting factor endowment. Further, it also leads to the production of inappropriate products, bringing considerable distortion in the developing country's consumption pattern.

The technology thus transferred also does not get a self-sustained development in the developing countries for the R & D efforts are so limited that hardly any self-sustained growth of technology can take place.

While technology has to be imported, it has to be selective. The first task of a developing country is to develop various measures to protect itself from many adverse aspects of international transfer of technology. The role of the Government is very important. It is indeed worthwhile to study Japanese experience. They purchased technology with minimum of these costs. The Japanese Government was a dominant partner in bargaining the collaboration agreements

Under the guise of transfer of technology, very often trade marks and brand names are sold. This would cost necessary outflow of foreign exchange. These trade marks and brand names also have serious impact on the growth of local industry and local brand names.

One of the most important areas in which confusion arises is the mechanism of transfer of technology. It is being transferred under four forms,

subsidiary, majority ownership of industry, minority ownership and technical collaboration. Most of the developing countries believe that the best mechanism to transfer technology from abroad would be via the control of host country in the industry and minority ownership of the foreign collaborator. Further, they also believe that technology transfer through technological collaboration agreements are the best vehicles of transfer. Experience has, however, shown that these forms are a necessary first step to keep the control on the industry by the host country, but they do not guarantee any protection from the ill-effects of the indiscriminate transfer. In fact, technology transfer through technical collaboration as it is in the experience of India is accompanied by a large number of restrictive clauses. In the case of some firms in other developing countries, it was found that the control on technology being critical despite regulation, the entire operation was in foreign hands. The Government of the country, therefore, should look into these various aspects in formulating its policy. It should play a critical role.

Transfer of Technology Among Developing Nations

T. N. Chaturvedi

For developing countries, transfer of technology has come to acquire a meaning beyond the physical aspect of gaining access to technical skills. It is being regarded as the most important tool for bringing about the desired economic development. The developing countries have given top priority to expansion of their industrial base through harnessing resources in men and materials for achieving a self-generating economy. A judicious implementation of the technology transfer programme has therefore, become an essential pre-requisite for facilitating rapid industrialistion.

Modes of Technology Transfer

Before taking up the detailed consideration of the issue, it would be appropriate to state briefly the various modes through which the transfer of technology from one country to another can take place. These can be broadly categorised as :

(*a*) *Through Foreign Investment* : A part of the capital, majority or minority, and technological resources are brought into the host country by the foreign firm. In such a case, the financial participation acts as a vehicle of technology transfer. The local contribution is to the extent of providing the balance capital, infrastructure, skilled and unskilled man power etc. The control of the enterprise is either in the hands of the foreign firm or the local partners depending upon the proportion of the equity held. The technical know-how comes from the foreign firm under a separate agreement which may or may not involve additional payment.

(*b*) *Through Technical Collaboration :* The firm in the host country purchases the know-how from a party in another country on purely payment basis. The payment consists of lump-sum or royalty (related to a percentage of turnover) or a combination of both. The transfer of technology brought about by this method does not affect the pattern of management of the host firm.

(c) *Through Equipment :* Technology is in a large measure embodied in the equipment employed. "Equipment suppliers have served as an important source of technology in many developing countries. The arrangements have varied from the know-how that a salesman could supply with purchase of few machines to the design and installation of complete plants."[1]

(d) *Through Turn-key Jobs :* Here an organisation in the donor country is given the job of starting the plant and handing it over to the local firm. The services required under this include detailed planning and engineering, choice and procurement of equipment, initial training of personnel and ultimate commissioning. This is a slight variant of Category (b) to the extent that the job awarded is quite specific and relates only to commissioning of operations.

(e) *Through Arrangements on Government to Government basis* : The Government of a country makes technology and other facilities available to another Government under terms which are far easier than those which can be arrived at between two private parties. Such an arrangement generally applies to State financed projects like building Power Stations, Dams, Public Health Services, etc. This may also be incorporated in a biltateral plan of economic, trade and technical cooperation without any separate payment being involved in a transference of a specific know-how. Indian assistance in setting up power projects in Nepal and bridge construction in Bangla Desh as also the recent launching of "Aryabhata" are examples in this respect.

(f) *Through Centralised Purchase :* An organisation in the host country, preferably state controlled (to ensure effective horizontal transfer subsequently), purchases technology on an outright basis and after adapting it suitably passes on to one or more firms in the country. The payment by the individual firm in such a case is most nominal and a number of firms get simultaneous benefits. Such a method has the advantage that the central organisation in consultation with the collaborating firms can associate R & D Institutions in the country at the outset to achieve an increased degree of self-reliance over a period of time.

1. United Nations, 'The Acquisition of Technology from Multinational Corporations by Developing Countries,' New York, 1974, Page 35.

(*g*) *Through Consultants :* Here the technology transfer takes place through the association of consultants of two countries on a commercial basis. One consultant supplements the other to the extent of the capability available with him having due regard to the requirements of the job undertaken.

(*h*) *Through International Regional Seminars and Conferences :* These ensure exchange of information which are useful in promoting R & D activity. These help the country in keeping abreast of latest trends in developments giving it an opportunity to evaluate them in their own context for making continuous improvements.

(*i*) *Through Training and Education :* This is accomplished by sending personnel from one country to another for advanced training or acquisition of additional qualifications. These programmes are generally financed by international or inter-government organisations like UNDP, Commonwealth, Colombo Plan, etc.

"Because of the varied and complex nature of industrial operations, it is difficult to compare qualitatively, the various services involved in a technological transfer or transplant carried out through a direct investment (which itself may take several forms) with various alternative arrangements singly, or in combination such as licensing, a management contract, purchase of a turnkey plant, purchase of equipment, consultant services and the like. . . . . .

Logic, seems to lead to two main conclusions (1) that a relatively simple framework of social cost-benefit analysis needs to be applied to governmental policy-making regarding the choice or the use of alternative contractual channels of technology transfer and (2) that the practical application of such analysis requires that the problem be analysed, if not by case, at least according to various branches of industry in which the balance may be tipped one way or another by judging just one or a few important aspects influencing the comparative merits of different forms of technology transfer."[2]

2. W. A. Chudson, "The International Transfer of Commercial Technology to Developing Countries" UNITAR, New York, 1971 pp. 8-9.

Background

It may be worthwhile to have a look at the situation in which the developing countries found themselves initially. After freeing themselves from the yoke of foreign domination they inherited stagnated economic growth and mounting social problems brought about by it. Their known reserves of natural resources had been emptied or misutilised, having served just as supplier of materials to developed countries. They were plagued by the paucity of capital, management expertise and technical personnel. While they had plenty of unskilled labour, the skilled manpower was very scarce. There was no R & D in industries worth the name, as in the past entire dependence for the scientific research had to be placed on principals in the colonial country. They hardly had any capital goods and intermediate goods industries necessary for sustaining further industrialisation. Having missed the industrial revolution, their endeavour was to make concerted efforts to make up for the lost time by trying to compress in a few years what the developed countries took decades to achieve. This was the general picture obtaining in the developing countries.

Of course, some of these countries, like OPEC countries, after the price hike in petroleum industry, did have funds but they had the same level of development or more appropriately under-development as other emerging countries not endowed with the possession of liquid gold.

Assistance from Developed Nations

With such a situation prevailing in the developing countries, it became a matter of utmost urgency to look to the developed countries for the flow of investment and technology with the object of achieving concrete results in a short period of time, partly to offset the initial handicap and partly to fulfil the promise made to the people. The aim was to raise living and health standards of the populace, provide them with food and shelter, clothing and education, create employment opportunities and utilise to the optimum extent the resources available in the country. Thus the emphasis had been to acquire technologies developed and proved in advanced countries and borrow management techniques followed by them in achieving their present position in the world economy.

The developing countries were virtually forced to hustle deals with developed countries for ready-made and turn-key know-how. At that time, the many inherent shortcomings of such arrangements were not fully considered nor was the borrowing country aware of them. In many cases, the know-how came under the aid programmes of developed countries leaving very little choice to the recipient country. This concept of combining technology transfer with aid did not give opportunity to the developing countries to buy the most suitable technology or appropriate technology for a particular job. The developing countries were not, in any case, equipped to evaluate the technology and assess from the long term view the benefit of the assistance made available. The existence of sellers' market in transfer of technology did not improve the situation. The donor countries were mostly unfamiliar with the environmental conditions, level of skill and technology, type of infrastructure facilities and quality of raw materials available locally. Even if these parameters were known to them, they did not understandably make any efforts to adapt the technology for use of the developing countries for fear of making it more expensive in view of the high cost of development at home. For example, the electrical/electronic equipments manufactured from know-how transferred was suitable for operation under an ambient temperature of 20°C, instead of 27°C accepted for tropical and sub-tropical climates. The know-how imported for the control of processes required high degree of sophistication and skills on the part of local manpower which was really not available. Automation came in where a good proportion of manual operations could be used. The size of industrial plants proposed to be built was too large to be transported by the available facilities.

The technology given did not always take cognizance of the availability of basic and intermediate goods; for example, lining of chemical equipment by fibre-glass was advocated when ceramics could easily do the job. There is an interesting example where nickel (an imported item) was specifically added to produce steel as the composition of the steel in he donor country contained some traces of the metal. The realisation that this material was tolerated in the donor country, because it was found in their ore, came rather late. This was a case of the inadequate appreciation and assessment of the quality of the raw material of the host country.

As regards capacities proposed, they were also quite high for the require-

ments of developing countries. A multi-national firm advised production of magnetic tapes by which the entire annual requirement of the host country could be met by a months' production from the plant. The capital-intensive know-how was mostly ill-suited to the local conditions and did not always help to solve the problem of ensuring availability of goods, services and employment.

Even in the acquisition of technology through training of manpower sent to developed countries, the gap in the requirements of the recipient country and the training imparted was too wide. These personnel often got too specialised a training to be only efficient cogs in the works and not as 'do-most and know-most' people needed at home to take on the mantle of leadership to identify and solve problems related to the development. Only a minority proved equal to the challenge and a sizeable number found themselves ill-at-ease to fully use their training leading inescapably to frustration and thus caused more problems than they solved. Maladjusted to conditions in their own countries, a number of them migrated to cosier and well paid jobs abroad. Developing countries could hardly afford the luxury of having their none-too-abundant technical man power resources engaged in work not contributing directly to the economic growth. The need for doing advanced research and specialised functions in developed countries to spearhead the work in that direction could not be denied but the priorities did require more stress and emphasis on adaptive development and building up of a strong applied R & D infrastructure.

Benefits of Transfer Among Developing Nations

The above analysis is intended to highlight problems which arose in the wake of technology transfer from developed countries to developing countries in the particular context of the compulsion of circumstances. In retrospect from one angle, this could perhaps be considered unavoidable. This is certainly not to say that such a transfer has not produced appreciable benefits in various areas. It has contributed significantly to the development of the recipient countries and has brought them to a stage when they can think in terms of an effective programme of technology transfer among themselves in view of the expertise and skills which have been developed by them in relation to their own requirements. Of special significance in this context is 'Intermediate technology'. The

term intermediate technology was coined by E. F. Schumacher[3] in mid-1960's. "There are three main sources of intermediate technology. The first is the development of traditional indigenous production and servicing techniques. Productvtiy is increased through the application of scientific and technological knowledge often derived from elsewhere, but continuity with prevailing social and cultural conditions is maintained. The second source, at the other end of the spectrum, is the adaptation of technologies currently in use in the advanced industrialised nations, but in a way that greatly reduces the scale of activity involved. It should also make technology suitable for a different capital/labour ratio, as well as for the use of local materials and other resources. Occasionally included in this category are technologies which have been developed and subsequently outgrown by the advanced countries during the course of industrialisation, but which may now be considered appropriate to the economic and social conditions prevailing in the developing countries. Finally, there are areas in which it is neither possible to upgrade traditional techniques, nor to adapt advanced techniques. In such cases, it is frequently necessary to carry out research and development into totally new techniques fulfilling the basic requirements of intermediate technology."[4]

The advantages of transfer of technology among developing countries are manifold. When a developing country obtains technology from another developing country, it has the privilege of shopping in a buyers' market. The technologies thus available are those which have been developed, evaluated and further perfected under more or less similar conditions. The equipments and plants designed in the developing countries are less capital and more labour-intensive and are especially more suited to withstand the rigours of the climatic conditions, thus obviating the need for plant shut-down and modifications during teething period. If the technology transfer takes place through consultants, it is beneficial to have them from another developing country as they are likely to have much vaster experience of operation of a number of industries running under similar constraints. They also have much better acclamatisation capability to provide adapted technology to show

3. E.F. Schumacher "Social and Economic Problems calling for Development and Intermediate Technology" Mimeographed ; undated.
4. David Dickson "Alternative Technology and the Politics of Technical Change" Fontano, 1974, p. 154.

tangible results in a short period in the recipient country. By seeking training facilities in other developing countries, purposeful knowledge can be acquired for immediate use and benefit in the recipient country and can act as a spring-board for further R&D effort. Thus alienation and brain drain can be reduced to a great extent.

What then are the ways and means of promoting a more meaningful cooperation for transfer of technology among the developing countries? One of the important factors inhibiting such a transfer is the lack of information on each others' capabilities. "There are two basic problems of communication to be tackled; one concerned with the assembly and proper mobilisation of knowledge about appropriate, intermediate' technologies, the other concerned with its reception and utilisation at the receiving end, in the rural areas of the poor countries. Neither of these "communication systems" currently exist on any significant scale, and their absence constitutes a major gap in the aid and development efforts of both donor and recipient countries."[5]

"Technical information raises problems not only of availability (access to information) and compilation (collection, organization, distribution), but even more important, of content, and more particularly, how far it covers the whole range of existing technical possibilities." [6]

It is a pity that the developing countries know more about the developed countries, a reflex condition no doubt by the salesmanship of the developed countries who can afford to spend large sums of money in advertising their technological achievements. As the developing countries cannot match the developed countries in this respect, because of the limited resources, it is up to the international agencies like United Nations (UN) and Organisation of Economic Cooperation and Development (OECD), who are no doubt already doing notable work, to intensify their effort in this direction. This can be done by compiling the information on (a) areas in which the developing countries are in a position to export technology to other countries, (b) training facilities available along with institutions which can impart the same, and (c) panel of experts suitable for secondment abroad with their field of specialisation. As a complementary function, designated institutions in the

5. O.E.C.D. "Choice and Adaptation of Technology in Developing Countries"' Paris, 1974, p. 108.

6. Op cit, p. 154.

developing countries can bring out national registers on these aspects. Where necessary, assistance by way of funds and expertise should be freely made available to these institutions by the international agencies. Another factor is that the developing countries find it difficult to ignore the carrot of aid or soft loans through which developed countries often transfer their technology. Even though the technology component may be more expensive than that available from developing countries, the package becomes irresistible in view of the financial constraints in which the developing countries generally find themselves. An obvious answer to this is that the World Bank and the Asian Development Bank should come forward to freely finance projects in which the technology transfer is from one developing country to another and earmark a portion of their resources for this purpose.

Need for Guidelines and India's Policy Regarding Import of Technology

It is also necessary that the developing countries, who are in a position to offer technology, should reflect their experience vis-a-vis developed countries in steering clear of potential areas of later irritants which tend to create a feeling of economic domination by the donor country.

As far as Government of India is concerned, the basic policy is to welcome foreign collaborations on a selective basis in fields in which such collaborations will be of advantage to the Indian economy. The fields where such a collaboration is required are kept under constant review and the Government issues illustrative list of industries where foreign collaboration, financial and/or technical, may be permitted. The selective import of technology has been understandably stressed in the Fifth Plan document on ensuring that simultaneously with the import of technology, "a specific programme is formulated to not only assimilate and adapt technology but undertake the R & D for improving it. Such programmes must then be closely monitored." The emphasis is more on the absorption of technology quickly so that the entrepreneurs do not have the need to depend upon the collaborator for continuous production and are in a position to sustain further technological development through indigenous efforts.

In India, generally a minority foreign equity participation of less than

40 per cent is allowed in selected areas. However, cases involving export-oriented industries (minimum exports being 60% of the total production) and industries requiring sophisticated technology, a relaxation in this limit can be allowed. Basically, foreign investment is considered only as a vehicle of transfer of technology. To give technical orientation to the process of industrial development keeping in view the country's needs and priorities, the Government of India has recently set up a Technical Committee of the various government departments dealing with science and technology and industrial research. The object is to bring to bear a total approach to the problems of technology and industrial development. The function of the committee is to consider technological aspects of proposals involving the import of technology within the framework of guidelines issued from time to time and offer a single-point integrated opinion keeping in view the availability of the technology and capability within the industry, the type of technology needed for its future requirements and the arrangements for inter-linking of the imported technologies with indigenous R & D to ensure self-reliance in the shortest period of time. The committee also calls the parties to explain their proposals at the meeting so that a consolidated view is taken for ensuring optimum utilisation of the technology.

A recent sample survery has revealed that most of the R & D effort in the industry is directed towards import substitution. The average expenditure on R & D as a percentage of the turnover in the surveyed firms works out to 0.95%; the variations being from 0.07% in prime movers to 2.39% in telecommunications. There is, therefore, need in improving the R & D effort for assimilation of technology. Also, an analysis of foreign collaboration applications received by the Technical Committee after July 1974 shows that the collaborations were weighted heavily in particular sectors like transportation equipment, electrical equipment, industrial machinery, etc. The foreign collaboration or extensions of agreements mostly involved multiple import of technology and were mainly sought from the marketing point of view. On the basis of these findings, steps are, therefore, afoot to ensure a more effective horizontal transfer of technology.

A clear set of guidelines for ensuring a purposeful technology transfer from the country, therefore, becomes a *must*. The Government of India has been all along quite particular in this regard. Majority Indian

participation in joint ventures overseas is not normally permitted unless it is specifically requested and is considered essential for the implementation of the project.

More developed of the developing countries like India* who have the required capability to export expertise and know-how in a variety of fields have not organised themselves in having their consultancy firms registered with the international agencies (like UN) for the award of sub-contracts. The sub-contracts have, therefore, not given their way even in areas where they are better equipped to give consultancy and prepare feasibility and project reports, because of their having done similar jobs under identical conditions. For marking a determined bid to wrest such an initiative, it is worthwhile to form a bank of best talents in the shape of a consortia of organisations to offer efficient and competitive services for specific projects. The Indian experience of organisation like Projects & Equipment Corporation, Engineering Projects (India) and Indian Consortium of Power Projects, deserves particular mention in this context.

There is also the need to set up an organisation to evaluate the quality of goods available in developing countries so that the recipient countries do not entertain doubts about the efficacy of the transferred know-how. Unfounded suspicion of getting sub-standard equipments have driven many developing countries to developed countries even though they would have preferred to obtain the technology from another developing country. In India, the national certification scheme operated by the Indian Standard Institution, and more particularly, the pre-shipment inspection by Export Inspection Council require to be made use of more and can with advantage be followed by other countries.

Last but not the least, are the procedural bottlenecks which are the bane

* In international meetings, India has come to acquire the status of a country capable of giving technology. As a result of the understanding arrived at between the Government of India and UNIDO, consequent to the International Seminar on Technology Transfer held in '72, India has been initiating exchange of Missions with the developing countries in technology familiarisation/transfer programme. Under this programme, delegations from South Korea, Fiji, Philippines, Indonesia and Kenya have already visited India. Delegations from Malaysia, Thailand, Bangla Desh, etc. are expected in the near future. In the exchange of technological information with these delegations, the Indian Investment Centre has played a significant role.

of many countries. The red-tape and resultant delays in according clearances to donor as well as recipient country participation in the projects are surely not the best ways of instilling mutual confidence so very necessary for promoting successful joint ventures. Speedy and time-bound approvals at all levels are, therefore, essential and can hardly be over-emphasised.

It is felt that action on the lines suggested above would go a long way in encouraging a more positive exchange of technology among developing nations for their common benefits.

It would thus be possible to evolve a joint effort where the state, technological institutions and industry play their due role to establish a moving equilibrium for technological development so that its result can be manifested in the accelerated development of the country. It may also not be out of place to mention that the optimum advantage from the technology transfer process are obtained if the simultaneous effort to stress the importance of managerial, organisational and administrative effectiveness in the host country continue to be made with a view to reinforce the growing technological capability.

Role of Indian Investment Centre[7]

The Indian Investment Centre was primarily set up to stimulate the flow of foreign private capital and technical know-how into India. However, over the years, IIC's assistance to entrepreneurs has taken various forms. Besides providing the necessary information and contacts for the setting up of joint ventures in India, the Centre provides effective assistance to Indian entrepreneurs for the setting up of joint ventures abroad.

The Indian Investment Centre, both at the headquarters and the overseas offices has been identifying investment opportunities and providing background information on terms and conditions on which joint ventures are permitted in various developing countries and within the guidelines formulated by Government of India (see Annexure I) for Indian participation in joint ventures abroad.

7 For details refer T.N. Chaturvedi, "Foreign Investment/Collaboration in India"; The Indian Journal of Public Administration Vol. XX No. 3, July-Sep. 1974.

Indian Investment Centre has also undertaken compilation and storing of all relevant information on economic and political conditions, investment, exchange control, taxation and import policies, the laws relating to corporate bodies, the pattern of foreign trade, their foreign exchange situation, etc., in respect of various developing countries. In fact, the Centre has already brought out country profiles on Malaysia, Ghana, Indonesia, Fiji, Philippines, Iran and Nigeria. The Centre has also developed close liaison with a number of developmental agencies in various countries like Ghana, Indonesia, Malaysia, etc. IIC also maintains close contacts with Indian Missions in various developing countries to keep itself abreast of the changes in investment policies, economic and political conditions, etc. The Missions also refer to IIC specific enquiries or fields where investment possibilities exist.

The Indian Investment Centre is actively associated with the industrial promotion activities of UNIDO. The IIC participated in the meetings organised by the UNIDO for such promotional activities held in Vienna, Rabat, Manila, Nairobi and Kuala Lumpur.

The growth of small industries in India has amply demonstrated that it is one of the ways of promoting new entrepreneurial and managerial talents, for ensuring equitable distribution of income and in increasing employment opportunities. The small scale industries, through expansion and diversification, lead to the establishment of medium scale industries by the emerging class of competent entrepreneurs. Thus, the objective of diffusion of ownership dictated by the national policy for curbing concentration of wealth and monopolistic tendencies is served.

With the experience gained by India in the establishment of small industries and industrial estates, where all infra-structural facilities such as power, water, constructed sheds, etc., are provided, India is now in a position to co-operate with other developing countries in this field, particularly, in identifying industries for development formulation of suitable development programmes, planning and establishment of industrial estates and generally organising a variety of extension services, including provision of technical advice, marketing assistance, improvement of designs, etc. The areas in which India is in a position to provide knowhow and consultancy are given in Annexure II. In fact, a number of experts from India are now advising and assisting some of the developing countries for promoting similar programmes. In this connection, it is relevant to

point out that the Industrial Estate Project in Nairobi, Kenya, is looked upon as a very successful venture and the Kenyan authorities are appreciative of India's assistance in this regard. Details of various projects abroad with Indian assistance on stream or under implementation are given in Annexure III.

India's competence in the establishment of an enterprise on collaboration basis as well as the ability to offer technical assistance is being internationally recognised. At the various meetings convened by the UNIDO to promote specific industrial projects in Asian and African countries,India has been invariably invited as a potential country to offer technical and industrial collaboration to developing countries. In fact, in the Third Asian meeting on Promotion of Joint Ventures between developed and developing countries organised by the UNIDO at Kuala Lumpur in November 1973, India was identified as a resource-giving country.

In recognition of the role being played by the IIC in the field of promotion of joint ventures abroad the Government of India is associating the Centre in its programme of economic cooperation with other developing countries. The IIC was represented in the delegations sponsored by the Government for such purposes to Nigeria and Manila. The Executive Director of the Centre has been nominated as the Chairman of the Indo-Yugoslav Sub-Committee for economic cooperation in third countries.

The Indian Investment Centre maintains a close and effective liaison with the other organisations concerned with technology development such as Department of Science and Technology, Directorate General of Technical Development, Council of Scientific and Industrial Research, National Research Development Corporation, etc. so that it is in a position to give information on the extent and level of availability of indigenous technology to the interested parties for the purpose of establishing joint ventures in India as well as abroad. The IIC is further strengthening its capability to promote more effectively the Technology Transfer to other countries by providing a clearing house of information on the subject.

Annexure I

General Guidelines Governing Indian Participation in Joint Overseas Industrial Ventures

(i) Normally minority participation only by Indian parties is allowed. The intention is that Indian parties should not insist on majority holdings abroad, but if the foreign party and the foreign Government are willing to accept majority Indian participation, there would be no objection. Government favours association of local parties in foreign countries; also local development banks, financial institutions and local Governments, wherever feasible.

(ii) No cash remittance will be allowed except small amounts required in connection with preliminary expenses for setting up the company abroad.

(iii) Indian participation should be in the form of indigenous machinery, equipment, technical know-how, etc., required for the new venture. Value of structurals, steel items, construction materials, components, etc., are not allowed to be capitalised. However, where the value of machinery, etc. falls short to make up the necessary reasonable equity and there is need to retain Indian equity holding at a level higher than what is obtainable through export of capital goods alone, there will be no bar to consider such cases on merits for permission to include structural, steel items and construction materials (but not components) to the extent these are required for the particular project against Indian equity.

(iv) Machinery, etc. exported should be of Indian make; no second-hand or reconditioned machinery would be allowed for export against Indian investment.

(v) Normal import replenishments, as available to exporters under the import policy for registered exporters, will be allowed on export against equity capital.

(vi) Cash assistance, if otherwise admissible, will also be allowed on exports of machinery and equipment against Indian equity, subject, however, to a ceiling of 10 per cent f. o. b. value.

(vii) Indian industrialists should as far as practicable, propose turnkey jobs, as this will lighten the responsibilities of the foreign investor.

(viii) Indian parties should as far as possible provide in their agreements with the foreign parties for training facilities in India to nationals of the country of investment.

Annexure II

Areas of Know-how for Industries and Consultancy Services

A. Know-how for Industries

1.	Cement plant	Complete
2.	Cane sugar plant	"
3.	Textile mills	"
4.	Vegetable oil complex	"
5.	Crushing and grinding plants	"
6.	Tea plants	"
7.	Foundries	"
8.	Rolling mills	"
9.	Sub-stations and electrification projects	"
10.	Transmission line projects	"
11.	Asbestos Cement sheets and pipes manufacturing plant	"
12.	Alcohol plants	"
13.	Rice mills	"
14.	Materials handling units	"
15.	Chemical plants	Part
16.	Petroleum refineries	"
17.	Petrochemical plants	"
18.	Fertiliser plants	"
19.	Paper plant	"
20.	Air conditioning, heating and ventilation units	Complete
21.	Complete railway projects	"

B. Consultancy Services

1. Roads, bridges and highways
2. Water supply and treatment schemes
3. Sewerage and effluent disposal
4. Town planning, urban and civic development and architecture.

5. Design of public buildings—schools, technical institutes, office buildings, hospitals, commercial buildings, hotels, auditorium, cinemas, airport terminals
6. Electric power generation—thermal, hydro-electric, nuclear
7. Power transmission and distribution
8. Multi-purpose projects—irrigation, drainage, power and flood control
9. Techno-economic survey to cover different sectors of the economy
10. Geological surveys
11. Oil exploration
12. Mining development schemes
13. Construction of railways and projects for increasing speeds of trains
14. Port and harbour development
15. Standards institutions
16. Industrial testing centres
17. Industrial research and development institutes
18. Safety codes institutes
19. Economic planning institutes
20. Statistical institutes.
21. Industrial financing institutions
22. Investment promotion centres

Annexure III

Indian Joint Ventures Abroad
(as on 28.2.1975)

Country	*Indian Collaborator*	*Field of Collaboration*
1	2	3
1. Afghanistan	M s T. Abdul Wahid & Co., Madras	Leather Tannery
	M/s Bharat Commerce Industries (P) Ltd., New Delhi.	Spinning plant
	M/s Everest Packaging Corpn., Bombay.	Corrugated Boxes and other packing materials
2. Canada	M/s Anil Hardboards Ltd., Bombay.	*Hardboards
3. Ceylon	M/s Jay Engg. Works, Calcutta.	*Sewing machines
	M/s Swastik Glass Works, Chandrapur.	*Glass factory
	M/s Bhor Industries, Bombay	*PVC leather cloth
	M/s Sahaney Steel Press Works, Bombay.	Auto electrical parts
	M/s Oberoi Hotel (India) Pvt. Ltd., Delhi	Hotel
4. Cyprus	M/s Modi Spg. and Mfg. Mills Ltd., Modinagar.	Cotton yarn & sewing thread
	M/s R.M. Goculdas, Bombay.	Cylinders
5. Ethiopia	M/s Birla Bros., Calcutta	*Textiles
	M/s Bombay Soap Factory, Bombay.	*Soap factory
6. Fiji	M/s Wallace Flour Mills, Bombay.	*Flour Mill
7. Hongkong	M/s Korse (I) Ltd., Bombay	Stationery items
8. Indonesia	M/s Bharat Commerce & Industries, New Delhi.	Spinning plant
	M/s Mahindra & Mahindra, Bombay.	Water meters
	M/s Century Spg. and Mfg. Co., Bombay.	Textiles
	M/s Raymond Woollen Mills, Bombay.	Engineers' steel files
	M/s Tata Exports Ltd., Bombay.	Storage batteries
	M/s Karamchand Premchand (P) Ltd., Ahmedabad.	Textile mills
	M/s Advani Orlinkon Pvt. Ltd., Bombay.	Welding electrodes

1	2	3
	M/s Ambica Mills Ltd., Ahmedabad	Malleable casting for pipe fitting & sockets
	M/s Andhra Steel Ltd., Calcutta	High tensile reinforcement.
	M/s Southern Steel Ltd., Calcutta	Cold rolled box strappings
9. Iran	M/s Mahindra & Mahindra. Bombay.	*Spare parts, automative components
	M/s Indian Aluminium Cables, New Delhi	Malleable castings
	M/s Gabriel India Ltd., Bombay	Shock absorbers
10 Ireland	M/s Mafatlal Industries Ltd., Bombay	*Tufted carpet yarn
11. Kenya	M/s K.T. Dongre & Co., Bombay	*Gripe water
	Shri R M. Goculdas, Bombay	*Textiles
	M/s Raymond Woollen Mills, Bombay	*Woollen Textiles
	M/s H.L. Malhotra & Sons Calcutta	*Light engineering complex
	M/s Orient Paper Mills, New Delhi	*Paper, pulp project
	M/s Indian Cork Mills. Bombay	*Cork factory
	M/s Atlas Cycle Industries, Sonepat	Bicycle Industry
	M/s Sarabhai 'M' Chemicals (P) Ltd. Ahmedabad	Pharmaceuticals
	M/s Salvi Super Structures, Bombay	Cast iron foundry
	M/s J.K. Synthetic; Kanpur	Synthetic filament yarns
12. Libya	M/s Indian Hume Pipe Co., Bombay	Pipes
13. Malaysia	M/s Godrej & Boyce, Bombay	*Steel furniture
	M/s Birla Bros., Calcutta	*Cotton textiles
	M/s Gupta Machine Tools, Calcutta	*Precision tools & gauge Mfg. Unit
	M/s Parry Confectionery, Madras	*Confectionery
	M/s Kirloskar Electric Co., Bangalore	*Electric motors pump diesel engines
	M/s Ajit Industries, Bombay	*Enamelled copper & electric accessories.
	M/s L.G. Balkrishnan & Bros., Coimbatore	*Time and automobile chains
	M/s Murugappa & Sons., Madras	*Cycle & Industrial chains

Transfer of technology from one country to another may take place by one of the means, such as through training and educational programmes, consultants, purchase of patents and licences, know-how agreements, turn-key jobs and foreign investments.[7] The first three are generally described as 'soft ware' devices and the rest as 'hard ware' ones. The U.N., through its exchange programmes, helps the international movement of scientists and engineers as a means of technology transfer. In many countries it is taking place through the establishment of a branch company or the participation of the owner of the know-how as a shareholder in the undertakings set up in the recipient countries. Know-how can also be transferred by supplying scientific literature, passing on of research findings and supplying maintenance instructions.

Japan is a unique example of absorption of transferred technology which produced miraculous results in the field of manufacturing.[8] The important reason for success was heavy investment made by Japan in plant and equipment, set up through imported technology. During the post-war period (1945-72), she was able to import as many as 8,561 items of advanced technology: and during 1951-60, the industries based on transferred technology produced about 25% of the total manufacturing output. The rate at which the technology flows from the advanced to developing nations depends on the social and geographic conditions as well as educational and technical standards of the recipient countries. Japan has spent an average of 50 million yen annually, for research and development on imported technologies, compared to 20 million yen for her indigenous technology since the year 1963. Whenever needed, she did not hesitate to take loans to meet the financial requirements of the imports of capital equipment, raw materials, etc., but rarely allowed equity participation of the foreign firms.

The favourable social environment prevailing in Japan is rarely to be noticed in other developing countries, where there is not only inadequate capital and technical expertise, but a traditional culture not quite suited to the adoption of modern science and technology. Besides this, lack of adequate number of technologists pose serious problems for the development and absorption of imported science and technology.[9] In order to reap the real advantage of the imported technology, the developing nations should be prepared to spend large amount of funds on the adaptation and further improvement of the same.

IPR vis-a-vis Transfer of Technology

India has rich experience in borrowing technologies even during her pre-independence days, mainly from the United Kingdom.[10] With the advent of independence, she has been in a position to borrow technical know-how from other advanced countries as well. Her approach in this area became more systematic since 1957. The Industrial Policy Resolution of 1956 welcomed external capital investment, with minimum control in management and with guarantees for reasonable repatriation of profits and earnings. Between 1948-65, 2,723 agreements with foreign concerns for the import of technical know-how were signed in India. The number of such agreements increased to more than 3,000 by 1971 and to about 4,000 by 1972. The important areas of such collaborations are iron and steel, fertilizers, petrochemicals, shipping, etc. This has enabled the country to develop a sound base for science and technology and use them in industries producing milk powder, vegetable protein, television sets, wood pulp, certain elements for atomic reactors, cement, sugar, chemicals, etc.[11] The best method of developing a sound technological base in the developing countries should be to pursue a course of 3 phases[12]; importing technological know-how, adapting and improving the imported technology and then promoting indigenous technology. In the initial stages, most of the developing countries propose to import know-how along with industrial plants and equipments. After developing a sound technological base, a few of such countries have been able to shift the emphasis from the importation of plants and equipments to that of technology alone.

The nations that are prepared to supply technological know-how are those of capitalist as well as socialist Europe, the United States of America, Canada, the Soviet Union, Japan and China.[13] The capitalist West has contributed to the technological growth of a number of developing countries in Latin America, Africa and Asia. The socialist countries are supplying their know-how to selected developing nations like Chile, Cuba, Algeria, North Vietnam, North Korea, India and a few others.

Choice of Appropriate Technology

Technology transfer, according to Pearson Commission, can be made

to play an important role in annihilating the disparity in the distribution of world GNP between developed and developing countries.[14] But the real problem of the latter is to make a choice of imported technology and to find out the methods of its transfer. This depends on a comprehensive survey of the actual needs of the recipient countries. The countries which are prepared to supply the know-how, should also help the recipient countries to determine the actual needs.[15] Once such needs are determined, the decisions can then be made about the appropriate technology to be transferred, because the same type of technology may not be found suitable to the different conditions prevailing in the developing countries. The highly capital-intensive and labour-saving technologies may, in fact, cause harm to developing countries like India, Pakistan, Bangladesh and Indonesia, which are in need of mostly labour-intensive devices for a warranted rate of economic growth. Sir Maurice Fiennes, the UNIDO consultant, has a great deal of discussion on the findings that ill-digested technology and inadequate capacity of absorbing it have led to 40% wastage of scarce capital investment in the developing countries.[16] If it is true, it is a matter of grave concern to the most of the developing countries, which under no circumstances, can afford wastage of this magnitude.

This wastage can, undoubtedly, be kept to the minimum, by making a proper choice of the techniques and technologies to be borrowed. The primary aim of the developing countries should be to choose whether it needs capital-intensive or labour-intensive technologies, to decide whether the whole or part of the technology should be imported and finally with equity participation or with no such participation.[17]

India is a developing country with limited capital and suffers from a low level of production and an inflationary bias. With such a serious handicap, India has to choose an appropriate technology corresponding to either of the two well-known investment criteria such as one promoting maximum social marginal productivity advocated by H.B. Chenery and others,[18] secondly, that of capital-intensity maximizing re-investment quotient, advocated by Hervey Liebenstein. The technology, either imported from other countries or developed within the nation, should be so selected as to maximize the nation's productivity within a planned period of time, so that it can help avoiding the inflationary bias, so widely and deeply affecting the life in India today.[19] A suggestion which can have popular support in India is Liebenstein's criterion, that is, the

capital-intensive techniques should be applied to the basic, key and defence industries ; whereas Chenery's criterion of social marginal productivity, that is, the labour-intensive techniques, should be applied to the remaining industries.

The danger of capital-intensive technology is that it is likely to enrich a small number of entrepreneurs gradually assuming monopoly powers in manufacturing and business, thereby accentuating the inequality between the richer and poorer sections by helping uneven distribution of national wealth and income.[20] Even in the United States of America, such sophisticated technologies have provided ample opportunities for the growth of monopolies and combinations, and has been unable to save the glut areas from poverty. The introduction of capital-intensive technologies should, therefore, be limited to certain selective sectors, as mentioned above, managed and owned by the public sector. The aim of technology in promoting maximum social welfare may be defeated, once such imported technologies fall in the hands of private entrepreneurs, whose main object is the optimisation of private net monopoly revenue. The social marginal productivity criterion suggested by Chenery need be introduced to all other sectors in order to create more employment opportunities in the labour-rich economies like that of India.

The innovators, in the Schumpeterian sense, capable of taking risks in the introduction of advanced technologies, and new output, exploring new sources of raw materials and new markets, with nation-building motives, are rarely to be found in the developing countries, where the short-sighted entrepreneurs like to invest all their resources in quick-yielding avenues and real assets.[21] It is the responsibility of the State to see that the imported technologies should, under no circumstances, accentuate the existing inequality in the distribution of national income.

The states in developing countries have also a great responsibility in creating, a scientific atmosphere and imparting scientific training and education, to one and all, so that it may enable the concerned personnel to absorb the imported technology into the existing system in an effective manner. Nearly, three decades ago, the then prime minister, Pandit Nehru, took the initiative to set up a number of national laboratories and research institutions to help the growth of technically-oriented industries in the country. Fortunately,

1	2	3
	M/s Jg Glass Industries, Poona	*Glass bottles
	M/s C.I.P.L.A.	*Cosmetics & Pharmaceuticals
	M/s Hindustan Safety Glass, Calcutta	*Safety glass
	M/s Mukand Iron & Steel, Bombay	*Steel foundry
	M/s Tata Oil Mills, Bombay	Vanaspati, soap etc.
	M/s India Pistons Ltd., Madras	Piston components
	M/s Berar Oil Industries, Bombay	*Palm oil fractioning plant.
	M/s Chemical Construction Co. New Delhi	*Hydrogenation of palm oil
	M/s Mysore Govt. Soap Factory, Bangalore	*Sandalwood soap
	M/s Phalton Sugar Works, Bombay	*Sugar factory
	M/s Chemical Construction Co., New Delhi	Fatty acid and Glycerine
	M/s Vinod Sanghi, C/o Shah & Sanghi, Bombay	Tube valves
	M/s Lakshmi Textile Exporters, Coimbatore	Textiles
	M/s Zaverchand Gaekwad (P) Ltd., Baroda	Metallic flexible tubes and hoses
	M/s Soundarajan & Co., Madras	Biscuit factory
	M/s Camlin (P) Ltd., Bombay	Stationery items
	M/s Harasha Elec. Appliance Co., New Delhi	Tubelas heating elements
	M/s Jyoti Ltd., Baroda	Pump
	M/s Saru Smelting (P) Ltd , Meerut	Flux cord, solid solder wire etc.
	M/s Universal Radiators Pvt. Ltd., Coimbatore	Radiators, oil coolers
	M/s Garware Nylons Ltd., Bombay	Nylon & Polyester yarn and fabrics
	M/s Kwality Textile Assooiation Pvt. Ltd., Polloche.	Spinning mill
	M/s Sarabhai 'M' Chemicals, Baroda.	Pharmaceuticals Plant
14. Mauritius	M/s Sidharath Jeshubhai, Ahmedabad	*Mosaic tiles & rolling shutters
	M/s Swastik Rubber, Bombay	*Rubber product industry
	M/s Orkay Group, Bombay	*Textiles
	M/s United Agencies, Bombay	Hotel projects
	M/s K.C,P. Ltd., Madras	Cement plant

1	2	3
	M/s Raymond Woollen Mills, Bombay	Readymade garments
	M/s Karamchand Premchand Ltd., Ahmedabad	Terry Towel Mfg. unit
15. Nigeria	M/s Birla Bros., Calcutta	*Engg. goods
	M/s H.L. Malhotra & Sons, Calcutta	*Razor blade factory
16. Philippines	M/s Kirloskar Oil Engines, Poona	Diesel engines
	M/s Chemical Construction Co., Ltd., New Delhi	Direct coconut processing plant
17. Singapore	M/s Teksons (P) Ltd., Bombay	*Automobile accessories
	M/s M.S. Alloy Electrodes, Bombay	Welding electrodes
	M/s G.K. Singhania, Bombay	Shipping
	M/s Chemical Construction Co. (P) Ltd., New Delhi	Mfg. of stearic acid
	M/s Ramon & Demn Ltd., Bombay	Automobiles straights
18. Tanzania	M/s Mukand Iron & Steel Works Ltd., Bombay	Mini-steel plant
19. Thailand	M/s Sacha Exporters & Investors, Bombay	*Steel mill
	M/s Birla Bros., Calcutta	*Synthetic fibre spg. unit
	M/s Gwalior Rayon Mfg. & Veg. Co., Ltd., Bombay	Viscose Staple fibre plant
	M/s Thermodyne Pvt. Ltd., Faridabad	Semi-conductors
20. Uganda	M/s Birla Jute Mfg. Co., Calcutta	*Jute mill
21. United Kingdom	M/s Birla Bros., Calcutta	*Asbestos cement products
	M/s Royal Fancy Sweet-Meat Saloon, Bombay	*Sweet-meat factory
22. U.S.A.	M/s Ghai Lamba Catering Consultants (P) Ltd., New Delhi	*Restaurant, Chicago
	M/s Ghai Lamba Catering Consultants (P) Ltd., New Delhi	*Restaurant, New York
	M/s Indo-American Electrical, Calcutta	Magnet wires
23. West Germany	M/s Kirloskar Oil Engines (P) Ltd., Poona	*Oil engines, rice milling machines etc.
	Shri N. Krishnan, Bangalore	*Hose-clips
	Shri B.A. Chandran, Madras	Non-ferrous forgings
24. Yemen Arab Republic	M/s Hindustan Tool Industries, Bombay	*Builders hardwares
25. Dubai	M/s R.M. Goculdas, Bombay	Cylinders

*In Production.

Transfer of Technology from Developed to Developing Countries

Subas C. Pati **Prahallad Panda**

No nation can think of a rapid economic growth without a sound technological base of its own. Technology revolutionalises commerce and production and adds quality to the work of the professional and trade guilds. It has, therefore, become customary for the entrepreneurs of the developing countries to import technology from the industrially advanced countries, rather than using domestic technology to build their manufacturing concerns.

The advanced countries, at present, have accumulated enough experience of passing on technological know-how and supplying industrial plants to the developing countries.[1] The supply of know-how by the advanced nations is an important factor conducive to a rapid economic growth of the nations that receive them by training skilled national personnel, who in turn would enable the developing countries to solve the engineering and scientific problems faced by their industries.

The developing countries are those which have certain common characteristics like stunted economic growth, abundance of unskilled labour and scarcity of capital, technical manpower and managerial skills.[2] These economies are mostly the suppliers of raw materials. They have missed the first industrial revolution, but now they are making all possible efforts to raise their standard of living by rapidly industrializing themselves. They have, therefore, given due importance to the role of science and technology in stimulating their programmes for industrialization. The Pearson Commission has pointed out the glaring disparities between the developed and developing countries so far as technology is concerned. The Commission has also suggested the need for technological development for solving the problems of their economic welfare, industrial exploitation and natural resources.

Role of UN Agencies

All the developing countries are now trying to acquire skill and import know-how from the developed countries which have already made advances in the field of science and technology. Technology transfer from advanced countries is now a current phrase among national planners, scientists and technocrats of what is called the Third World.[3] Technology being an important determinant of economic growth, its transfer from advanced countries has obviously received renewed interest. Imported technology, to the developing countries, has contributed to their industrial growth, strengthened their competitive ability in the world market and accelerated their technological innovations in order to achieve economic parity at international standards by progressively narrowing the existing technological gap with the developed countries.[4] The United Nations agencies are playing an important role in assisting the technology transfer from the advanced to the developing countries. Having gathered early momentum in the field of technological development, the developed countries have a moral responsibility to help the new-comers by supplying technological know-how and training their personnel so as to be able to solve their engineering and scientific problems in industrial development.

To facilitate the transfer of technology, 'Science and Technology Aid' has been proposed by the United Nations as a part of the global development aid. The U.N.'s 'Advisory Committee on the Application of Science and Technology (ACAST)' for the 'Second United Nations Development Decade' has recommended a 'World Team of Action for the Application of Science and Technology to Development.' UNIDO is taking increasing interest in helping the industrialization programmes of the developing countries with the help of technology transferred from the developed countries. And in this, they are assisted by other U.N. agencies like ILO, UNESCO and U.N.'s Regional Economic Commissions in Latin America, Africa and Asia. The U N., therefore, seems to take keen interest in developing a strong foundation of science and technology in the developing countries in order to help them build a modern industrial system.[5] They have felt the need for importing 'know-how for products and processes, design engineering and marketing expertise, engineering consultancy and management services coupled with a massive effort by the recipient countries on developing their own know-how and infra-stucture by way of R & D facilities.[6]

financial needs of laboratories have been met from time to time. These laboratories and institutes have created an army of trained scientists and specialists, prepared to help the introduction of imported technology, and at the same time develop them further in the light of local conditions. It is high time that they should help to formulate a plan of education on the basis of the special needs of the country.

The developing countries can reap great benefits from the imported technologies by using them specifically in the export-oriented industries. The international organisations like UNCTAD, UNIDO and OEA are there to help these countries in this matter, even by promoting their R & D facilities.[22]

For the successful development of imported technology, the building of a technological infrastructure, and adequate availability of trained technical manpower is essential. Indigenous R & D capability should be built to assimilate and adopt the imported technology. The nations which do not have a well-developed R & D infrastructure should send their scientists to the advanced countries to carry out basic resesarch. Their knowledge in research abroad would be helpful in building R & D infrastructure in the home country. The U.N. agencies such as UNESCO, UNIDO, WHO, FAO, etc. are there to extend their helping hands in this matter.

In order to make a proper choice of technology to be imported, a survey need be made regarding the market potential at home and abroad, price and demand conditions, ability of the market to pay, etc. A market research organization with the main function of data collection in framing R & D programmes should be set up in the recipient countries. In countries like Japan and Australia the R & D programmes were linked to the national planning policies and priorities. If technology is to be imported for the promotion of research, it should be introduced in the most profitable and commercial channels. There should be an active agency whose main task would be to supply technical imformation and services to the research managers. The research managers need be dynamic and forward looking. In India, the Government have provided 95% of the finance needed for the R & D programmes of the country; and sponsored schemes like the national laboratories which have long-range research programmes and technological planning.

It is to be admitted that even today our industries are largely depending on imported know-how. Efforts should, therefore, be made to harness the indigenous technology to the maximum possible scale and import that part of the technology which can be manageable with the available scientists and technologists. The country should try to manage with minimum of foreign participation. The growth of indigenous technology is more relevant to the developing countries as it is free from the exploitation of the advanced nations economically and politically, and further it progressively makes these nations technologically self-reliant.

The total expenditure on science and technology in India was Rs. 270 million in 1958-59; it increased to Rs. 1,360 million in 1969-70. It constituted less than 0.5% of her GNP, compared to 1 to 3.1 of the GNP in some of the advanced countries. The corresponding percentage is 1 to 2 for Europe, 3.2 for the USA and 4.3 for the USSR.[23] The CASTASIA (1969) have recommended that the developing countries should increase their R & D expenditure to 1% of their GNP by 1980, that is, by the end of the Second U. N. Development Decade. The advanced countries should also continue to assist technology programmes of the developing countries so as to increase their expenditure level, and devote at least 5% of their non-military research and development expenditure for the benefit of the developing countries.[24]

A suitable science policy can help the less developed countries to better utilise their technological capacities. This policy includes incentives for innovation, financing of technological institutions, disincentives for excessive importations, development of technological capacity through the fiscal instruments etc. The National Committee on Science and Technology is doing useful function in framing a Science and Technology plan for India, in correspondence with her Five-Year Plans.

Moreover, the developing countries like India should encourage minimum direct foreign investment as a part of their technology importation programmes. The areas of such investments are mostly restricted to the extractive industries like petroleum, plantation and mining which normally benefit the developed countries more than the developing ones. Direct foreign investment of this sort causes quick repatriation of huge dividends to the foreigners, and ultimately leads to social loss. It is the responsibility of the State to see that the industries introducing imported technology should have minimum possible idle or excess capacities.

REFERENCES

1. Pronikov, A. S. — "Technology Transfer between Developing Countries", Discussed in the International Seminar on Technology Transfer, New Delhi, December, 1972.
2. Ramaswamy, G. S. — "Technology Transfer Between Developing Countries", Discussed in the International Seminar on Technology Transfer, New Delhi, December, 1972.
3. Tarapore, Savau S. — "Transmission of Technology to Developing Countries" in *Finance & Development,* Vol. 9, No. 2, June, 1972.
4. Haun, S. J. — "Factors to be Considered in National Planning Policy with Respect to Transfer of Technology", Report: Regional Seminar, Problems of Transition from Laboratory Research to Industrial Application, UNESCO Publication, New Delhi, P. 67.
5. Havemann, H. A. — "The Transfer of Technology: Some International Aspects". Discussed in the International Seminar on Technology Transfer, New Delhi, December 1972.
6. Singh, Baldev — "Technology Transfer and National Policy". Regional Seminar. UNESCO, New Delhi, Page 39.
7. Ramaswamy, G. S. — loc. cit.
8. Haun, S. J. — ID/W.G. 110/10, 18th October, 1971.
9. Fiennes, Maurice — Commentary Papers (C1) in the papers presented in the International Seminar in Technology Transfer, New Delhi, Dec., 1972.
10. Roy, T. K. — "Transfer of Technology in a Developing Country and the Role of the Project Engineer", Regional Seminar, UNESCO, New Delhi, P. 91
11. Baransok, Jack — "Economic and Social Considerations in Adapting Technologies for Developing Countries", *Technology and Culture* (Winter 1963) pp. 22-29
12. Jedlicki, C. — "Strategy for Transfer of Technology in Chile" International Seminar on Technology Transfer, New Delhi, December, 1972.
13. Pearson Commission — 'Partners in Development', Report of the Commission on International Development, London, 1969.
14. U.N.C.T.A.D. — "Guidelines for the Study of the Transfer of Technology to Developing Countries", in 'A Study of UNCTAD Secretariat' pp. 5-7.
15. Fiennes, Maurice — loc. cit.
16. U.N.I.D.O. — ID/WG. 14/32, 2nd July, 1968 pp. 6-8.
17. Chenery, H. B. — "Application of Investment Criteria," *Quarterly Journal of Economics,* February, 1953, pp. 76-96.
18. Kahn, A. E. — *Quarterly Journal of Economics,* February, 1951.
19. Galenson, Walter & Liebenstein, Henry — "Investment Criteria", *Quarterly Journal of Economics,* August, 1955.
20. Jedlicki, C. — loc-cit.
21. Schumpeter, J. S. — Capitalism, Socialism and Democracy.
22. Puri, I. K. — "Technological Transfer in Industrialisation of Developing Nations", Discussed in International Seminar on Technology Transfer, New Delhi, December, 1972.
23. Havemann, H. A. — loc. cit.
24. O. E. C. D. — Table VI-2, Development Assistance, Effects and Policies of the Members of the Development Assistance Committee, *OECD, 1971 Review,* December, 1971.

Development and Transfer of Indigenous Technology : Problems and Prospects

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Ever since man changed from his nomadic way of life and started organising himself, inventions and innovations have started growing. The rate of growth of innovations, however, was dependent on the needs and exigencies that existed at a particular place at any point of time. The two World Wars gave a big boost to the development of technology in Europe and America, with the result two distinct categories of nations, viz., (i) developed, and (ii) underdeveloped (now called as developing) came into being. In the last two decades, however, the world has come much closer and in the present situation, even the developing nations have something to contribute to the body of knowledge. This paper presents some of the problems that occur in the development and transfer of technology and the prospects that lay ahead, particularly, for a developing nation like India in the years to come.

Type of Technology Required

Technology is defined as the "Science of Industrial Arts" which means it is a mixture of techniques with which man can change the environment by using the natural resources. The development of technology is essential for industrial growth, which in turn is imperative, if a nation is to raise the standard of living of its people and also keep up, if not advance, its position in the technologically advancing world. The type of technology that is required by the developing nations, therefore, varies widely when compared with that of the advanced countries. Advanced countries need technologies that are labour-saving, cost reducing, sophisticated and efficient. On the other hand most of the developing countries which still have enormous untapped natural resources suffer due to inadequate capital and lack of technical and managerial skills, though they have abundant labour force. Other factors that are peculiar to them are level of social and economic

* The views expressed in this paper are those of the author and do not reflect those of the organisation.

development, size of market, unemployment, climatic conditions, etc. These countries, therefore, need technologies which will match with their capabilities and limitations.

Sources of Technology

The sources of technology for advanced countries are :

(i) R & D institutions of big industrial establishments ;

(ii) Scientific and Industrial research laboratories of the State ; and

(iii) Research laboratories of technical colleges and universities.

Developing countries which do not have a large industrial base have to depend very much on imported technologies for their development. However, countries like India do borrow technology and innovation from the following sources :

(i) The network of national laboratories ;

(ii) Research laboratories of public sector enterprises and government departments like Railways, Defence, P & T, etc.;

(iii) Research and development laboratories of some established industries ;

(iv) Laboratories in IITs and Universities ; and

(v) In a small measure from individuals.

Transfer of Technology

It is said that the generation of world knowledge is doubling itself every 15 years, and therefore, if the world community is to benefiit by this "knowledge explosion", it is essential that the generated knowledge is disseminated quickly. This can be achieved by :

(i) Transfer of technology from the developed to the developing countries ;

(ii) Transfer of technology between developing countries ;

(iii) Transfer of technology within a developing country ; and

(iv) Transfer of technology from a developing country to developed countries.

Though much has been said and written on the ways of transfer of technology, this paper limits itself to study of the transfer of technology within a developing country like India.

Methodology of Transfer

In the above paragraphs, it has already been mentioned about the main sources of technology from which an industry or an entrepreneur can draw their requirements. In a country like India the bulk of the know-how comes from the network of national laboratories, and these are transferred to the industry/entrepreneurs through NRDC of India. The various steps involved in the process of transfer are :

1. Process assignment by CSIR and others to NRDC.
2. Preliminary study of the process by NRDC and collection of additional information, if required.
3. Process evaluation and preparation of feasibility reports—This is done either by the technical staff of NRDC or by engaging consultants, depending upon the work involved and the expertise needed.
4. Publicity through mass media—like newspaper advertisement, seminars, get-togethers, personal contacts, demonstration and circulation of preliminary technical notes.
5. Furnishing of additional information and clarifications, if any, to intending parties.
6. Discussion and finalisation of terms and conditions and issue of formal offer to the party.
7. Initial payment by the party and signing of the agreement.
8. Release of process details and demonstration of process by the laboratory concerned.

An idea regarding the number of processes referred to, and the number of processes transferred by NRDC in the last 5 years for exploitation on a commercial scale is shown below :

Number of Agreements Signed by NRDC in The Last 5 Years for Various Processes

Year	*No. of Agreements Signed*
1970-71	90
1971-72	135
1972-73	200
1973-74	238
1974-75	268

Problems Encountered

As may be seen from the above table, the performance of the NRDC in desseminating technology to industry has been satisfactory. But the transfer, however, has not been without problems. Some such problems encountered are discussed below :

(a) Even though a number of processes are referred to NRDC every year for transmission to industry, quite a number remain unsold despite the best of efforts. This problem arises out of the fact that the problems chosen for research are sometimes different from the practical needs and requirements of industry which gives an impression that they are chosen at random.

(b) Some entrepreneurs who borrow know-how do not have the necessary educational background to understand and assimilate the technology. Even if they do understand the process, they are not able to set up a plant because of their inability to design and engineer the process.

(c) Bulk of the processes available with NRDC for commercialisation are those that are developed only on a laboratory scale or at the most bench scale. Very few processes are backed up by pilot plant work. In some cases, even the pilot plants that are put up are not

pilot plants in the real sense, as the scale up factor required for commercial design based on the data available from them is very high, which makes the plant design very difficult. When such a know-how is offered to industrialists or entrepreneurs, they are rather reluctant to accept it as they fear the process may not be a success on a commercial scale.

(d) Entrepreneurs who approach NRDC for borrowing technical know-how are varied. They include industrialists, technocrats, fresh graduates, retired or retiring army and civil men, and sometimes, men with poor educational background from the rural areas. They expect that the know-how packet offered to them will consist of project report, process details, engineering design, fabrication drawings, tender specifications and even tenders from suppliers of equipments, proposals for erecting and commissioning the plants on a turn-key basis etc. Some of them expect financial particpation either in the form of a grant or a loan. Most of these people are not in a position to appoint engineers or avail the services of engineering consultants to do the scale-up, design, fabricate and erect the plant. Inability of either NRDC or the R & D institutions to give such a process package is one major problem faced while transferring technology.

(e) There is a general feeling among the prospective clients seeking the know-how from NRDC that they should get the process exclusively. They demand that the process should not be given to anybody else, once they sign an agreement with NRDC. This is because they fear that if the know-how is given to a few others, there will be unhealthy competition and they will lose their market. This fear is more predominant in those who borrow the know-how first. Their claim is that being pioneers, they do all the bull work and face the bulk of the problems in translating laboratory process to a commercial scale, whereas the subsequent licensees of NRDC cash upon their experience and expenditure. They argue therefore, that NRDC should not issue any further licenses, or even if it does, they should be given some concession with regard to the premium and royalty that is to be paid for the know-how. But, they forget that in seeking to fulfil their own interests, they are undermining the national interest. They overlook factors such as :

(i) Whether they can meet the entire demand for a particular product?

(ii) What would happen if they do not put up the plant for one reason or the other ?

(f) Another common, probably, genuine expectation from the potential licensees of NRDC, is about the guarantee on the process performance when implemented on a commercial scale. They want a guarantee from NRDC that if the process fails, the expenditure incurred by them will be compensated. While putting up such a stiff demand on NRDC, at least some parties do offer to pay a handsome know-how fee, provided the know-how is offered to them with the necessay guarantees.

(g) There are some who want every kind of assistance like market survey, feasibility reports, process know-how, grant of loan, erection of plant and even sale of the product, from NRDC. There is yet another category which does not want to pay any kind of know-how fee to NRDC. They claim that, as many of the research institutions and NRDC are government bodies, the know-how generated by them should be made available to the citizens free of cost.

(h) Some other factors which come in the way of quick transfer of technology are:

(i) element of imported raw material in the process developed ;

(ii) necessity to have some imported equipments ;

(iii) the pilot plant or laboratory set up has been dismantled, thus making demonstration difficult;

(iv) process still under development and some more work has to be done;

(v) the scientist who developed the process has resigned or gone on long leave or gone abroad.

Thus, there are many problems which do come up from time to time, making the task of the technology selling organisations difficult.

Viable Solutions

Obstacles which come in the way of technology selling organisations

are not unusual while selling "know-how" and they are quite prepared to meet them. In the NRDC of India, some steps have been taken which have proved quite effective. Some of them are discussed in subsequent paragraphs.

(a) A special proforma has been designed by NRDC to collect required information on the process referred to it. Additional information or clarifications are also obtained from the laboratories after studying the basic data furnished. Experienced engineers of the organisation visit the concerned laboratories and then prepare technical appraisals and also summary thereof for preliminary circulation. For large projects or for processes which require special expertise, the services of consultancy organisations are commissioned to evaluate the process developed by a R & D institution, and prepare a feasibility report. In the last one year, about 30 technical appraisals have been prepared by the staff of NRDC. There are quite a few reports prepared by the consultancy organisations. These reports are sold at nominal price to the prospective entrepreneurs. This approach has created a lot of confidence amongst entrepreneurs borrowing know-how from the NRDC because they are now quite sure that the data given to them, particularly, on capital investment, cost of production, etc., are more realistic than before. As the reports are good and at the same time cheap, they need not go again to consultants to get the feasibility reports done.

(b) Another step that the NRDC has taken for the development of indigenous technology is setting up of pilot plants and prototype units. This is being done in collaboration with a user industry so that once the project is a success, the process is immediately taken up for commercial exploitation. The NRDC has so far sanctioned projects worth Rs. 5.9 crores, its own contribution being Rs. 2.9 crores. Several others are in the offing. Some of the successful NRDC projects are :

(i) Lightning arrester
(ii) Integrated protein project
(iii) Pentaerythritol
(iv) Syntans
(v) Infant food
(vi) Pine Oil
(vii) SAN plastics
(viii) Dall Milling, etc.

The salient feature of this scheme is that the money given by the

NRDC for the project is refundable without interest on an agreed basis, only if the project is a success. If the project fails, NRDC writes off the expenditure incurred by it, without claiming refund from the collaborator.

It is not always possible for the NRDC to set up pilot plants for the various processes referred to it. Not only would this need huge grants from the government, but would also be time-consuming. Whereas, for some processes no pilot study would be necessary, for some others the pilot trials could be tried out with the existing facilities. For example, a coating composition to make direct copy paper has been developed and the process is available with NDRC. Instead of waiting for the NRDC to set up a pilot plant for coating the material on paper to produce the direct copy paper, some existing industrialists who are specialising in the manufacture of coated papers should come forward to take the process and make application trials with the coating machines available with them. Such a participation by existing industry, would give a great fillip to the development of indigenous technology in India. If the trials succeed, they will be the beneficiaries and if the process fails they will not lose much. Small loss, if any, could be written off against their R & D expenditure. Strangely, industries in India are reluctant to take the NRDC processes because of the fear that the project would not be a success. As the success of a process depends more upon the person who is borrowing the process than the process itself, it is certain, that if industrialists who have the infrasructure for R & D, come forward to try out the NRDC processes, most of them will prove successful.

(c) It was mentioned earlier that many entrepreneurs in India are not fully equipped to understand the technology and set up commercial plants. They depend very much on the laboratory or the NRDC for engineering and setting up the plant on a turn-key basis. Unfortunately, both the NRDC and the research institutions are not adequately equipped to do the scaling up and put up the plant on a turn-key basis for their clients. However, some effort has been made by the NRDC to offer some processes on a fully engineered basis, availing the services of consultancy organisations. Some examples are :

(i) High speed bicycle gear
(ii) Pentaerythritol
(iii) Chlorates and perchlorates
(iv) Paper from Jute sticks and other agro wastes

(v) Infant food

(vi) Protein isolate

(vii) Caffeine from tea wastes

(viii) Carboxy methyl cellulose

(ix) D.O.P. & D. P.P.

(x) Acetanilide

(xi) Electrolytic Manganese di-oxide, etc.

The NRDC hopes that in future it will be able to do some more on similar lines. If the research institutions can strengthen their engineering sections and give a design package at least for small projects, it will accelerate the pace of transfer of technology. Similarly, existing NRDC licensees who have set up factories could come forward in offering design package through the NRDC for the future licensees.

(d) The desire to take processes on an exclusive basis does not seem to be tenable. In the past, some licenses were being given both on total exclusive basis or zonal exclusive basis. Theoretically, such an arrangement showed some advantages, but in actual practice, this was not achieved. On the contrary, such type of contracting resulted in a number of processes remaining unexploited because the persons who borrowed the know-how on an exclusive basis did not put up the plant for one reason or the other (they could not arrange for finance, or they could not get the raw materials, the market conditions changed, they changed over to some other line of manufacture, or simply they lost interest), thus preventing genuinely interested parties from getting the know-how. As it was clear that granting exculsive licenses does not help either the licensee or the NRDC, a policy decision has been taken not to give exclusive licenses any more. This raises a question, what will be the limit to the number of licenses for any particular know-how ? While in principle there could be no limit, the matter will, however, be reviewed from time to time and the number determined after studying the performance of the earlier licensees the demand for the product, availability of raw materials and other factors.

(e) The demand or expectation by entrepreneurs to obtain the necessary guarantee for the processes sold by the NRDC does not seem to be unjustified. Even when we buy a product from a shop, we ask the shopkeeper whether the quality is good and whether it is durable

which is an indirect form of guarantee that we are asking for. Therefore, as buyers of know-how with the ultimate aim of investing money for setting up a plant one would definitely like to be sure that the process they are opting for would work. But unlike a product which is a finished one and can be seen, the know-how is abstract and is only an ingredient in the production of an ultimate product. So it is extremely difficult, particularly, for a selling organisation like the NRDC to give guarantee for all the processes that it is selling because there are several factors, beyond its control. Perhaps, it could offer guarantee to processes which are already established but not all. If it were to sell processes only with guarantee, then it will have to follow stiff criterion for the selection and acceptance of processes which will not only be time-consuming but would defeat the purpose for which it is set up, viz., transfer of technology. Therefore, a certain amount of calculated risk has to be necessarily taken by entrepreneurs while purchasing the know-how. The entrepreneur need not be unduly concerned over this because, if he is really capable of assimilating the technology and is also capable of bringing in the necessary inputs, the technology would definitely be a succes. And both the NRDC and the research institutions would be with him until he successfully completes the project. In order to reduce the element of risk and infuse more confidence in entrepreneurs, the NRDC (as already pointed out), has devised methods like (i) setting up pilot plants (ii) prior process evaluation, (iii) offering know-how as a package through consultancy organisations, etc. Also, the possibility of the NRDC participation in the risk capital, particularly, for big projects is being seriously thought of.

(f) A good process can become a failure if it falls in wrong hands, whereas, an ordinary process can become a success, if the person taking it has the necessary where withall. This shows the importance of the selection of entrepreneurs before a know-how is offered. Thus some personal data are collected from the entrepreneurs before a particular know-how is offered to them.

A Dig into Future

The future for indigenous technology both in India and abroad is bright. With the present trend in increasing demand for more processes, they

can be sold provided they have relevance to the actual needs of an industry or import substitution or export oriented or has something unique and is of mass consumption.

To create a dent into the foreign market, the NRDC has established many contacts with similar organisations in USA, UK, Japan and other countries. Project profiles prepared by the NRDC are being sent to the foreign agencies periodically, for information and publicity. The processes available with the NRDC (India) are now being advertised by agencies like International Licensing, London in their publication. The participation of the NRDC in the UNIDO conferences and direct visits by their senior staff to the technology selling organisations of the world, the activities of the NRDC of India, and the processes available with it for commercialisation have become known to many outside India. As a result, lot of enquiries are being received, of late, from abroad, seeking information on the processes available with the NRDC, terms for setting up projects on turn-key basis and other technical advice. A sample of technologies which have been sold to foreign parties are :

(i) Suri Transmission - West Germany
(ii) Improvements in or relating to the modification of Aluminium-based alloy—West Germany
(iii) Activated carbon—Philippines
(iv) High draught kiln—Nepal.

Negotiations are under way for the sale of the following technologies:

(i) Dry ready to wet sausage casings—Sweden, UK
(ii) Carboxy methyl cellulose—USA
(iii) Wet heat resistant leathers—USA
(iv) Dioctyl pthalate—Turkey
(v) Arc Carbon for cinematograph projectors—Srilanka.

It is observed here that offers for most of the technologies mentioned above are being sent on a turnkey basis with a tripartite collaboration viz., the NRDC, the licensee of NRDC and an engineering consultancy organisation.

Technology Transfer through International Collaboration in Research and Development

N. P. Singh G. Janaki Ram*

The concept of Technological/Research and Development collaboration between different countries is an old and established one. While technical/financial collaboration amongst industries ensures the flow of established technologies from advanced countries to developing countries, R & D collaboration among them ensures that the financial, manpower and material resources available in different countries are pooled together for development of new technologies and improvement of existing ones for the mutual benefit of the co-operating countries. The realisation of this concept of International R & D collaboration in actual practice is of great significance for developing countries, as they cannot obviously afford huge investments in R & D over prolonged periods. Further, in a country like India, which possesses the third largest pool of scientific and technical manpower in the world, creation of facilities to conduct sophisticated research in this country based on appropriate forms of international R & D tie ups can also help in alleviating the problem of unemployment among scientists and technologists to a certain extent and checking, if not altogether stopping, the much-talked about brain-drain.

In recent years, India has signed agreements for co-operation in the field of science and technology with a number of countries, specially in Europe and the Afro-Asian region, but these agreements between the Governments and the working programmes drawn up thereunder are primarily confined to the formulation and execution of joint programmes, exchange of personnel, etc., between Government-run or controlled industries, institutions and laboratories of the collaborating countries. There thus appears to be some need to evolve a policy instrument for making the benefits of international collaboration available to a large section of scientific community working in other private/public sector industries, research institutes, foundations, etc.

It is generally accepted that industrial Research, Design and Development (RDD) is best done in close proximity to the production lines. With

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this in view, Governments in developing countries have, of late, been encouraging in-house R & D work in the industries. In India, over 200 R & D departments within the industry have so far registered themselves with the Department of Science and Technology for availing of benefits consequent to such registration. Collaboration between such in-house R & D units in one country with similar units in other countries is apparently viable and would deserve to be encouraged for joint and faster development of new technologies by such industries for their mutual benefit. Further, under such an arrangement the new technologies would be 'born' in two or more co-operating countries simultaneously, and thus the problems in the field of transfer of technology as amongst the co-operating industries would be simplified.

Self-Reliance in Research and Development

In its Final Report, (12th February, 1973), the sub-group on Research and Development under the Indo-British Techological Group, sponsored by the then Ministry of Industrial Development with the objective of 'studying ways and means of increasing the self-dependence of Indian companies in research and development while ensuring the maximum benefit from the advances made by foreign collaborators and licensors', has observed as follows :

"6 (A) Steps required to be taken by Indian industry :

(viii) Indian companies with foreign equity often have the advantage of low-cost access to international technology. These companies should make use of this technology which is available to them on *favourable terms* as long as this does not inhibit the indigenous R & D effort. They should be encouraged to make technological contributions to their international group, *thereby assisting in striking a balance between the inflow and outflow of technology.*

(ix) Consideration should be given to the identification and development of R & D collaborations which are mutually beneficial to India and the U.K."

While granting approval to new foreign collaboration cases, Government

has now been imposing a standard condition that the Indian firms should set up adequate R & D facilities for absorption and adaptation of the imported technology and its further improvement. Experience so far has, however, shown that this provision has not been effective in actual practice. The reason is that this provision is self-defeating from the point of view of the Indian Industry which is interested in continuing its tie up with the foreign collaborator for not merely technological but also commercial reasons. Thus, if the Indian company sets up adequate R & D facilities and is successfully able to absorb and adapt the imported technology within the sanctioned period of foreign collaboration, it has no further case for asking for the renewal of the collaboration agreement. On the other hand, if the Indian company does not set up such R & D facilities or merely makes a 'show' of setting up such facilities and is thereby unable to absorb and adapt the imported technology fully, Government would find it difficult to refuse the renewal of the collaboration agreement, as it could lead to the stoppage or loss of production. As a consequence, Indian industries set up initially on the basis of foreign collaboration find not taking up R & D seriously to their 'advantage'. A conflict thus emerges between private interests and the interests of the country (viz. its goal of technological self-reliance). *The search for an alternative way to promote the setting up of in-house R & D facilities by the Indian Companies having foreign collaboration in co-operation with R & D cells of advanced industries in foreign countries (on a commercial basis), where necessary, therefore, appears to be imperative.*

The study of a large number of foreign collaboration cases also shows that the flow of R & D information from foreign companies to their Indian counterparts is relatively un-inhibited (and without any charges) when the foreign equity participation is more than 40 to 50 per cent. On the other hand, when the foreign equity participation is low (generally less than 40%), and in cases of purely technical collaboration, any information regarding the advances made in technology is passed on by the foreign collaborators only on the basis of some definite consideration and not otherwise. However, this method of 40% or higher foreign equity participation for acquiring R & D information may not be the most appropriate method available to indigenous companies for such purposes. Besides, it is doubtful if actual 'production technology' based on such R & D know-how would be made available by the foreign companies without insisting on some additional considerations.

Again, it has been observed that a good number of Indian companies request for extension of foreign collaboration agreements on the ground that such renewals would help them in taking advantage of the latest advances in technology in the concerned field or that the collaboration is required for the manufacture of products having different capacities, ranges, etc. or for manufacturing 'improved' versions of the old products. Such extensions of collaboration agreements have actually been allowed by the Government of India in many cases, on one of these grounds or the other, and usually these involve continuance of royalty payments to the foreign collaborator (albeit at a reduced rate) and perhaps fresh imports of capital goods, payments of lump-sum know-how fee, etc. *This only shows that most foreign companies are constantly having a 'lead' over their Indian counterparts, due to a total absence or lack of the latters' RDD capabilities and—unless the Indian Companies at some stage are prompted, enabled and even compelled to build up their own RDD competence —such continuous dependence on foreign know-how cannot be prevented.*

Keeping this aspect in view, it is strongly felt that renewals of foreign collaboration ageements in the same (or similar) line of products should give place to acceptable forms of R & D tie-ups between the collaborating companies, so as to enable the Indian Companies to

(i) absorb the 'unabsorbed'/'incremental' portions of the foreign technology, if any;

(ii) build up their own R & D capabilities in specified areas, and

(iii) undertake future developments of technology, in cooperation with the foreign collaborators, on *mutually beneficial* terms.

Such RDD collaborations, it is considered, would enable the Indian industry to keep itself abreast of the latest advancements in technology in developed countries on the one hand and minimise out-go of foreign exchange through subsequent *wholesale* imports of technology in the form of capital goods, know-how fee, recurring royalty payments, etc. on the other. This concept of RDD collaboration has been further elaborated in subsequent paragraphs.

Need for Effective Utilisation of R & D Facilities

It will be noticed that special emphasis has been placed on research,

design and development (RDD) deliberately, even though design can be considered to form a part of the development activity. In the Approach Document to the Science & Technology Plan, it has been clearly mentioned that there has not been a determined effort to utilise the capabilites already developed in the country due to the absence of active agencies to promote indigenous technology and that the communication gap between industry and industrial research laboratory remains large. What is implied in the statement is that the process of transfer of technology for industrial purposes by suitable up-scaling of the laboratory results to pilot plant and commercial scale has not gathered enough momentum, primarily, because of lack of application of engineering and design skills. Therefore, in order to complete the innovation chain from concept to commercialisation, design (as also engineering) skills have been indicated as a separate activity.

For purposes of setting up industrial scale plants, design and development collaboration at least is certainly not unknown in India. For designing our steel plants, raw materials in considerable quantities have been sent abroad to our foreign collaborators for testing, for design of process equipment and machinery, e.g. blast furnaces, coke ovens, palletisation, etc. For engineering of cement plants and sizing of machinery also raw materials have been sent to our foreign collaborators. The suggestion to organise international collaboration in applied research is only an extension of the foregoing concept with a view to get basic information and the necessary inputs for design, development and engineering of full-scale plants.

There are certain consultancy organisations and industrial plant suppliers in India who have facilities for doing detailed engineering based on the small scale experimental or pilot plant studies conducted by them. However, there have been occasions when such studies have to be conducted on a larger scale for which these organisations cannot establish their own experimental facilities for obtaining empirical or semi-empirical data for engineering plant or equipment. They have relied on foreign collaborators quite often for generation of such data which is essentially applied research.

Likewise, there can be cases where the necessary input information can be generated in this country but there may be lack of adequate design

and engineering skills for exploitation of information generated for industrial purposes. International collaboration on a limited scale for obtaining basic engineering information upon which the Indian party can do detailed engineering should be welcome in such cases. Such collaborations can promote the use of domestic technology and also eliminate costly mistakes in engineering plants. Apart from this, the Indian industry will be in a stronger position to negotiate agreements for imports of technology or complete plants when they are aware of the precise gaps in knowledge in processes or engineering. This will also prevent repetitive imports of technology from various countries or even from the same organisation in one country by different Indian entrepreneurs.

RDD Collaboration and Transfer of Technology

The Colombo and New Delhi ESCAP Conferences have recognised the problems faced by developing countries in transfer of technology from the developed countries and have recommended the establishment of a Regional Centre for Transfer of Technology for Asia and the preparation of a feasibility report for its establishment. The object of setting up this Centre is to assist all the countries in the Asian region in developing capabilities in transfer of technology, avoidance of repetitive imports of technology and laying down the most suitable methods for transfer of technology from developed to developing countries and vice-versa. This is, in effect, the recognition of the need of this region for international RDD collaboration.

Before proceeding further, it would be appropriate to consider a few examples with reference to India :

A small scale industry located in Maharashtra which is engaged in the manufacture of marine paints and associated products, has been having a Government approved R & D tie-up from 1968 with a Danish firm, a Company of international repute in the same field. The Indian Company does not have any foreign equity participation and it assists the Danish firm in evaluating and improving its products in the tropical climate as well as in the execution of sponsored R & D projects. The personnel working in the Research and Development Laboratories of the Indian Company are all Indian Scientists/Engineers and the foreign

Company meets the entire cost of the collaborative R & D Projects. Both the Indian party and the foreign 'collaborator' are *free* to exploit the results of such joint research projects commercially anywhere in the world. The Indian party is not required to pay any royalty, etc., to the foreign company for such commercial exploitation.

Another Indian firm located in Haryana has recently proposed to enter into an R & D agreement with a well-known French concern to develop technology for the manufacture of Tri-oxane and Polyacetal Resins, starting with formaldehyde as a base. Stated briefly, the arrangement envisaged is that the existing process and experimental data in possession of the two firms are to be pooled up, pilot plant trials are then to be conducted (at Indian firm's cost) in India and the designs are to be checked and the quality of end products tested in France at the foreign Company's cost. The process to be finally developed would be a 'joint' process and the ownership of patents to be obtained in India, France and other countries would be 'joint and equal'. All commercial rights, including those for the sale of technology to third parties, would for the duration of the agreement (10 years or duration of the patents, whichever period is longer) vest in the Indian Company within India and in French Company within France and all other countries. Both the Indian and French firms would be *free* to exploit the process by themselves (or through their subsidiaries) anywhere in India and the rest of the world respectively, without having to pay any fee to the other side. For sale of technology to third parties by either side, however, the benefits would be shared by both sides on a 50 : 50 basis. The phrase 'benefits' would, for this purpose, be taken to mean 'Gross receipts minus promotional expenses of the selling party, which should not exceed 10% of the receipts'. After the expiry of the agreement, either side would be free to exploit the process anywhere in the world.

Recently, the Government of India have approved a case of tie-up between an Indian Company (located in Madras) and a well-known British firm, mainly to enable the Indian Company to obtain assistance from the foreign collaborators for establishing a suitable research and development base in India. The Indian Company has had approved licensing-cum-financial collaboration arrangements with the British Company for the manufacture of brake linings and clutch facings. The extension of this collaboration had now been allowed on the ground mentioned above, for another period of 5 years, on the basis of 0.5%

royalty on internal sales and 5% royalty on exports (both subject to Indian taxes), along with enhanced foreign equity participation. It has been hoped that with adequate R & D base, the Indian party would be in a position to offer some competition to an existing foreign majority company, which has been operating in this field in the country.

Of late, a number of progressive industrial groups have also approached the Government of India to permit R & D tie-ups between certain Indian industries and industries/research institutes in some of the developed countries with a view to enable them to develop their R & D capabilities and catch up with the technological developments taking place in the industrially advanced nations. The ultimate objective, of course, is the building up of technological self-reliance, so that continuous dependence on foreign know-how may be avoided and India may become a net exporter of technology in the world technology market.

Some of the contingencies in which the suggested international R & D collaborations amongst industries may be of considerable relevance and utility in the Indian context would seem to be as follows :

(i) If we wish to have a global market for the products of our technology, R & D collaboration between industries in different countries cannot perhaps be avoided. This would specially apply to areas of various sophisticated technologies and products, which a country like India might wish to develop with an eye on the export market.

(ii) Where a foreign company wishes to sponsor R & D problems in an Indian Company/R & D Laboratory and the cost of such research projects is met through inward remittance of foreign exchange, there should be no serious objection to such an arrangement. In fact, this would further help in providing gainful employment to many of our scientists/ engineers.

(iii) Likewise, when adequate facilities for certain highly specialised kinds of research and/or development work are not available in India or where the setting up of such facilities is likely to require investment of considerable resources and time, there can perhaps be no objection in letting an Indian firm sponsor such R & D problems in a foreign concern/R & D Establishment, subject to appropriate payments. The main aspects to be considered in such cases should be whether the

R & D problems in question are of relevance to the Indian scene and whether a little out-go of foreign exchange at this juncture would have the potentiality to save a much larger out-go at a later stage on account of whole-sale import of technology.

(iv) An international R & D tie-up can also be of considerable help to an indigenous company, which is planning to develop a certain technology anew, when the development of that technology in another country is already known to be in a much advanced stage. Looking forward to the need for optimum utilisation of our scarce resources, to avoid rediscovering what has already been discovered abroad, and in order to ensure that we do not perpetually lag behind in the field of development of new technologies, it would seem worthwhile to permit the indigenous company/entrepreneur to identify and bridge the initial technology-gap through 'imports' and then get going on his own from that stage onwards. Alternatively, a continuing R & D collaborative arrangement between the two companies can also be envisaged, so as to ensure a continuous exchange of ideas, information, etc., on new developments. In the latter case, however, it will have to be ensured that both the 'partners' in 'joint' projects share the industrial property rights which would eventually accrue on a just and equitable basis.

Outright R & D payments by subsidiaries of foreign companies to their principals should not, however, be permitted, as this arrangement would serve as a disincentive for the building up of indigenous R & D capabilities.

A stage thus seems to have come when the Indian industries, specially those in the established lines of manufacture, will have to be asked and even prompted to shift from the concept of licensing arrangements and financial collaborations to co-operation in research and development. The objectives of such R & D collaborations, as stated earlier, should be the development of new or improved technologies in the desired areas at minimum cost, through deployment of our own scientific and technical manpower in as short a time as possible and also to build up our technological capabilities and to lessen the out-go foreign exchange from the country through wholesale imports of technology in the form of capital goods payment of know-how fees, royalties, etc.

In the light of the above, it would appear worthwhile for the Government

to consider formulation of suitable guidelines (listed below) for the benefit of the Indian industries that might wish to pursue R & D programmes in collaboration with foreign companies or research laboratories as the case may be.

(a) The Indian Industry should have adequate competence in the area in which it wants R & D tie-up with a foreign party, so that it can derive fullest possible advantage from such an arrangement. One could thus insist that a pre-requisite for giving permission for any international R & D collaboration would be the establishment of proper in-house R & D facilities by the Indian industry to the satisfaction of Government.

(b) While there can, in general, be no objection to an indigenous company undertaking R & D work sponsored with it by a foreign party (subject, of course, to Govenment approval), the Indian industry should also be permitted to farm out well-defined R & D problems, specially in newly emerging and sophisticated fields, for solution by a foreign company or R & D laboratory in appropriate cases.

(c) Before any research problems are allowed to be farmed out to a foreign concern/R & D set up, the concerned agency or authority should be satisfied that solutions to such problems cannot be offered within the country at a reasonable cost and within a reasonable time.

(d) R & D contributions by subsidiaries of foreign companies in India to their principals should not be allowed, except within the strict framework of the guidelines for R & D collaboration to be laid down by Government.

(e) The industries/institutions participating in an international R & D venture should generally keep themselves free to exploit the results of research in their respective countries, while exploitation in third countries could be subject to mutually agreed terms and conditions.

(f) Such collaboration agreements must preferably be on a project by project basis and no omnibus across the board R & D hook-ups need generally be allowed.

(g) All international R & D collaborations amongst industries should be based on the principle of co-operation for mutual benefit and optimal

utilisation of manpower and material resources at both the ends for the achievement of their (common) objectives.

Conclusion

While international R & D collaborative programmes on industry to industry basis executed in a spirit of mutual benefit and co-operation can effectively dispense with the need for continued or repetitive imports of technology in various fields, specially by the developing countries, there is also the possibility of misuse of these by interested companies. Possibilities exist for uncontemplated payments under the guise of R & D collaboration. It is possible, for instance, for a branch of a multinational corporation or a foreign majority company, in the guise of R & D collaboration, to try to use the scienfitic and technical manpower in developing countries as cheap labour to serve the ends of its parent organisation, without enabling the countries in which such industries are located to derive any real benefit from the collaborative programmes. Some companies may not be keen about the success of our collaborative R & D programmes to favour the desire of their subsidiaries/associated companies for exploitation elsewhere. Many foreign majority companies already functioning in the developing countries, while intensifying their & D activities through international R & D tie-ups, may later come up with requests for expansion of their activities in such countries on the basis of claims for indigenous technology. International R & D tie-ups may also open up one more channel for possible entry of multinational corporations into the economy of the developing countries. Unless adequate safeguards are provided, industries which do not already have a reasonably strong R & D base, and the countries in which they are located, cannot hope to derive, from international co-operation in research and development, all the benefits which may accrue to them in the normal course.

If, on the other hand, international R & D collaborative programmes are evolved and executed by industries in the right spirit, it should be possible to find solutions to many complex technological problems faced by mankind at minimal costs and within much shorter time spans than might otherwise be possible. Perhaps, there is need for further thinking on the subject.

Transfer of Technology from R & D Laboratories to Industry in a Developing Country

M. S. Virdi

The subject of technology transfer has aroused much interest in the recent past, as our dependence on advanced countries for technology and technical know-how is on the increase. On the other hand, the technological gap between the advanced countries and developing countries is widening with the pace of time. It is this problem which needs serious thinking and ways and means have to be found out so as to achieve self-reliance with the indigenous know-how. Some views have been expressed in this paper to facilitate development and utilisation of indigenous technologies.

Project Identification

Before any project is initiated, it is essential to prepare a complete plan of the project. In many advanced countries, expenditure upto 5% is spent on the technical and economic feasibility studies. Applied Research and Developmental projects can always be planned since the objective is known. The success in a developing country like India is more guaranteed since similar work has already been done elsewhere in the world. It is suggested that as much as six months should be spent by the scientists on the programming and feasibility studies The programme should include, status of the technology in the world, marketability, phase out of the tasks to be carried out giving the time targets, requirements of resources at various time intervals in terms of staff, equipment, pilot plant and testing facilities, space, year-wise budget, products which will be developed with targets, etc. The programme may be put to a committee of experts for discussions. After the project is well conceived and scrutinized the complete facilities and budget asked for should be provided and periodically the project could be reviewed to evaluate the progress. Though few projects may be taken up but they should be provided full financial support. It is not possible to introduce accountability unless the resources asked for are fully provided.

Identification of User

It is true that all the laboratory findings are transferable. The technology transfer becomes easier if the project has been taken up after identifying the user and need for it. Sometimes, it has been found that the need has not been assessed and the user is unknown. In many cases the know-how is passed on to persons of the industry who do not have the ability to grasp the sophistication involved and it becomes very difficult to start the production or maintain the proper quality control. Chances of success of technology transfer from research laboratory to industry are higher if the project is well identified. It is advisable to associate the user at an early stage. If the persons or the users are associated from the beginning or at a later stage depending upon the sophistication involved, the transfer process becomes comparatively easier.

In the case of sponsored projects accepted by the CSIR laboratories, there is advantage because the user is known even before the project is started. Their personnel can be associated at the appropriate stage in the development process so that when they go back to industry they can set up the production facilities and start the manufacture.

Market Analysis

One of the difficulties in technology transfer is lack of sufficient marketing data. In many of the cases it is not known as to what will be the demand of the product produced in the country. An entrepreneur who has to invest his money would like to have the demand pattern so as to decide whether he should take up this product or he may like to evaluate comparatively with other products. In fact, the exact demand of a particular product should be known when the developmental project is initiated. In many of the cases it may be found that there is not sufficient demand for a particular product after its development. This leads to infructuous expenditure on R & D. In such cases it is better to import the product. But sometimes, the demand is generated with the indigenous availability of a particular product or an instrument although its import figures may be meagre to justify undertaking of its development. To cite an example, in the case of Electrostatic Photocopying Machines, its demand used to be a few units per year because

of foreign exchange difficulties and exhorbitant price which only large business houses could afford. Now its demand has increased manifold due to its indigenous availability and low cost. Many a time, demand has to be created for a new product which is not prevalent. Accordingly, an import statistics alone does not help in arriving at a conclusion. It is very essential to set up a market analysis group which may prove very helpful in deciding whether a project should be undertaken, and after the work is successfully completed it may provide data to industry on its demand and likely consumers. This would certainly help in the utilisation of indigenously developed products.

Feasibility Studies

Another problem is the preparation of the feasibility report. Whenever a project is completed, it is very essential to prepare a feasibility report. The entrepreneur desires to know the availability of raw materials, machinery demand pattern, cost-benefit analysis or discounted cash flow, etc., before he decides to risk his capital. The banks also desire to have feasibility reports for evaluating the proposals which they would finance. At present facilities have not been geared at many laboratories/institutes to prepare the feasibility reports and such work is entrusted to firms of consultants for the major projects. The feasibility reports should be prepared for all the completed projects and a cell should be established in every laboratory for conducting market surveys and preparation of feasibility studies.

Role of Consultants

In most of the cases, the processes are developed in the laboratories on a micro level. There exists a wide gap between the process developed in the laboratory and the production process. The gap could be bridged if the design and production engineers are associated to upscale the process. A firm of consultants could be associated who have the experience in the design and fabrication of machinery and plant in that particular field. Choice of consultants should be made after looking carefully into their past achievements, qualifications of staff working with them and field of activity. In order to ensure better technology transfer, it is essential to associate engineering

consultants to carry out the design and production engineering of the pilot plants, demonstration plants, industrial units or prototype fabrications based on the indigenous know-how developed in the research laboratory. In order to build up engineering and design capabilities in the laboratories it is proposed that a design and engineering consultancy cell should be set up in each laboratory/institute. In addition to the catering to the needs of the laboratory it could render consultancy services to industry in association with the scientists within the scope of the laboratory.

Another problem of technology transfer is lack of technical competence and capacity of the industry to adopt the technology developed. Whenever know-how is transferred to the industry, training is provided to their personnel for pilot plant study of the process or making prototypes etc., in addition to know-how manual. Even after the personnel of the firm are trained, it becomes difficult for them to successfully start the production and there is every possibility that the process remains unutilised. It is suggested that industry should gear up its capacity to absorb the indigenous technology as and when developed.

The CSIR has approved a scheme wherein scientists associated with development of the process could be deputed for six months to work at the premises of the industry (licencees) to set up plants, offshoot their production problems and establish quality control. Recently, NPL scientists have visited the plants of the licencees and have helped them to start production. The point emphasized here is that the system will not only be useful to industries, but scientists would also be benefited. They would learn from practical experience the problems faced on the shop floor, which can be dealt with more effectively when they develop another product in the laboratory.

Import of Appropriate Technology

One of the major obstacles in the growth of indigenous technology is the import of technology when indigenous technology has been developed already or it is under development. It has been observed where foreign technology has been imported on one pretext or the other, when the proven indigenous technology is available and the Indian firms are producing the material for the past several years on the ground that

major share of the production will be exported while the remaining share will be consumed in the domestic market. In such ventures the production capacity is so large that the component of production for domestic market itself becomes larger than the production capacity of small units utilising the indigenous know-how. This mars the interests of these manufacturers because of reputed trade names of their competitors. It is suggested that whenever licenses are granted to boost the exports, 100% of their production capacity should be exported. The Government should not import the technology wherein substantial effort is being put. There has to be inter-relationship between the policies for the import of technology and those of its indigenous development. It should be decided at the national level as to what technologies should be imported and what technologies should be developed indigenously. For instance, the foreign know-how has been permitted when the ferrite products developed by the NPL are being produced for the past several years. In fact, the NPL has been the pioneer to set up ferrite industry in the country. Such import of technologies creates problems in the transfer of laboratory know-how. It is not dearth of talent in the country, but only mobilisation of resources and collaborative efforts between scientists and technologists which is necessary for developing indigenous know-how.

In conclusion, it is suggested that entrepreneurs, who agree to help the development and utilisation of indigenous know-how, should be encouraged by giving of incentives in return for the risk taken by them. The incentive could be providing partly risk capital, performance guarantees, preferential treatment in import of essential capital equipment and raw materials, loans by financial institutions at concessional terms, etc. The indigenous technology could be better utilised by adopting such measures.

Transnational Corporations, Trade and Development

Thomas Ganiatsos*

The unprecedented spread of transnational corporations[1] in the last twenty-five years is altering traditional relationships in the world economy. In the following pages an attempt is made to review some recent evidence of the extent and importance of their activities in developing economies, to analyze those of their features that may condition their economic impact in those countries and to consider how their operations have affected the balance of payments.

Scope and Importance in Developing Countries

The inflow of private foreign direct investment to developing countries came to $3.2 billion in 1970 and $5.8 billion in 1973, representing nearly 28 percent of the total flow of financial resources that they received from developed market economy countries and multilateral institutions in the latter year.[2] The accumulated stock of foreign investment has been unevenly distributed both among regions and between countries within regions, as can be seen from Table 1. Although Latin America has been receiving a declining share of the total flow, manufacturing investment there was $71 per capita compared to $51 per capita in West Asia, $5 in South and East Asia and $22 in Africa.

Approximately a third of the accumulated direct investment in developing countries has been in petroleum and almost one half in the extractive sector as a whole. Manufacturing accounts for 30 percent of the total

* The views expressed in this paper do not necessarily reflect those of the UNCTAD secretariat.

1 The term "transnational" throughout this paper is used to refer to any corporation producing output in more than one country.

2 Calculated from Organization for Economic Cooperation and Development, *Development Cooperation 1974, Review*, Paris, November, 1974. The above figures exclude Southern European countries.

Thomas Ganiatsos

over 200 of them have sales in excess of $1 billion.

The technological prowess of transnational enterprises is impressive. In the United States they account for 52 percent of total private expenditures on research and development, of which only 6 percent occurs overseas.[9] Of the $2,760 million in overseas receipts of royalties and fees for the transfer of technology by United States firms in 1972, it is estimated that between 85 to 90 percent went to transnational corporations.[10] Moreover, three-quarters of the above sum came from affiliated firms, confirming the view that the inherent loss of control over licensed technology makes large firms unwilling to license technology to unaffiliated firms except where foreign regulations or market conditions make export or investment unattractive or impossible.

The internationalization of production, resulting from overseas investment, does not in any way appear to have been diminishing the role of transnational enterprises in world trade. Together with their majority-owned affiliates, United States parent companies' share of all world exports and world manufacturing exports was about one quarter ($73 billion) and one fifth ($39 billion), respectively in 1970, having increased slightly from 1966.[11] For the United States alone they accounted for about 62 percent of manufactured exports and 34 percent of manufactured imports in 1970.[12] Of even greater significance is the fact that out of total United States transnational corporation-related exports, almost half were intra-company exports.[13]

The concentration of a substantial portion of world trade in the hands of a small number of transnational enterprises brings into question the

9. But the figure of 52 percent becomes 80 percent if the highly research oriented aerospace and electronics industries in which TNC, are less important are excluded. Committee on Finance, United States Senate, *Implications of Multinational Firms for World Trade and Investment and for U.S. Trade and Labour,* United States Government Printing Office, Washington, 1973, p. 557.

10. *Ibid.*, p. 600 and United States Department of Commerce, *Survey of Current Business*, December 1973, p. 14.

11. Committee on Finance, United States Senate, *op. cit.* pp. 279-280.

12. *Ibid.* p. 322. A related estimate for the United Kingdom in 1966 indicates that 22 percent of that country's exports were accounted for by intra-firm sales. *Board of Trade Journal,* August 16, 1968.

13. Committee on Finance, United States Senate, *op. cit.* p. 319

relevance of traditional trade theory which is based on the assumption of competitive market determination of values. This is particularly true for that part of trade which is intra-firm trade and which "depends only indirectly on market demand, and can respond rather quickly to command decisions about sourcing and supply to customers that TNC managements may choose to make."[14]

Paralleling the growing concentration of transnational corporations in the world economy is a trend toward consolidation of internal decision-making authority within a hierarchical structure which delegates day-to-day matters to a periphery of operating subsidiaries, coordinative functions to a middle layer of regional or continental divisions and high-level global strategy to the board rooms of the parent companies situated in the principal financial centres, New York, London, Tokyo, Paris, Frankfurt, etc.[15] Implied in the increased centralization of decision-making is a unified approach to the management of the corporation's financial resources so as to maximize over-all profits. Central to this strategy is a system of accounting and money management which allocates expenses and revenues and raises funds over different parts of the organization in such a way as to minimize its over-all exposure to the risks of currency fluctuations, high taxes, credit restrictions, political instability and undesired dividend payments.[16] The greater the importance of interaffiliate exchanges of goods and services in the total volume of trade, the greater the rationale for such an approach.

Distribution of Benefits

It is clear from the preceding discussion that there does not exist an atomistic market setting in the international economy such that maximiza-

14. *Ibid.* p. 314. For a detailed discussion of these issues, see S. Lall, "Transfer-Pricing by Multinational Manufacturing Firms," *Oxford Bulletin of Economics and Statistics,* August 1973, pp. 173-195.

15. One cannot dismiss *a priori* the possibility, based on location theory, that the next ten or twenty years may witness a scenario in which the entire non-socialist part of the world economy is organized along such a pattern and managed from these centres by an exclusive, highly-paid corporate elite. See testimony of Stephen Hymer in *Summary of the Hearings Before the Group of Eminent Persons to Study the Impact of Multinational Corporations on Development and on International Relations,* (United Nations Publication, Sales No. E.74.II.A.9).

16. For a detailed discussion of operating policies regarding control and finance in United States-based transnationals, see S. M. Robbins and R. B. Stobaugh, *Money in the Multinational Enterprise : A Study of Financial Policy,* Basic Books, New York, 1973.

The results of this and similar aggregate studies are difficult to interpret because of the complexity of assumptions required. However, they do show that the terms and conditions under which collaboration with transnational corporations is accepted or invited need to be carefully scrutinized in developing countries in conjunction with consideration of alternatives to such collaboration. A number of practices by transnational corporations tend to reduce the size of balance of payments benefits as well as the contribution (if any) to economic development.

First, despite their considerable control over financial assets, there is a well known tendency for transnationals, particularly, in the manufacturing sector, to rely on sources outside of the home country for their financial needs (85 per cent in the case of United States firms). A substantial part of this financing comes out of local borrowing and internally generated funds (via depreciation and retained earnings) of the overseas affiliates, thus limiting the foreign savings contribution and possibly diminishing the financial resources available to productive local enterprise.[22]

Secondly, the arrangements for the transfer of technology by these corporations to developing countries—either through their own affiliates or through foreign businesses, frequently include restrictions on exports and the requirement that imported intermediates and other inputs be purchased from the parent or technology-supplying firm. In a recent study analysing 2,640 contracts for the transfer of technology in 12 countries, the incidence of such restrictions was shown to be quite significant, though their presence tended to be somewhat lower in countries having taken measures to control them.[23]

The existence of restrictive practices need not be formalised in written contracts. Informal arrangements between parent firms and the

22 See Committee on Finance, United States Senate, *op. cit,* p. 38 and *Review of International Trade and Development 1973, op. cit,* Chapter 3.

23 The percentages of sampled contracts in which export restrictions were found for various dates during the sixties were as follows :

Argentina 28%, Bolivia 83%, Chile 90%, Colombia 79%, Ecuador 75%, Ethiopia 71%. India 43%, and 47% (2 dates), Israel 11% and 67% (2 dates), Mexico 97%, Peru 99%, Philippines 32% and Spain 38%.

The incidence of tie-in restrictions (not separately shown but grouped together with limitations on output) ranged from 5 percent in Spain to 86 percent in Ethiopia. Summarized in 'The Role of the patent system in the transfer of technology to developing countries.' TD/B/AC.11/9), p. 49.

subsidiaries they control may achieve the same results. These arrangements are partly reflected in the significant volume of trade with overseas affiliates noted previously. Whether the trade is with affiliated firms or tied to the purchase of technology by unaffiliated firms, it provides a powerful instrument to the transnational corporation for extracting concealed monopoly profits from the developing country. Transfer pricing, therefore, is a *third* way in which balance of payments benefits may be depressed—either through over-charging for imported machinery and intermediates or through under-pricing of exports. Systematic data on the extent of this practice is still lacking. However, price comparisons for a limited number of product groups that have been made in Colombia, Chile, Ethiopia, Ecuador, Ghana, Iran, Peru and Spain show overpricing on some items to be as high as 300 percent.[24] Stated rates of return on direct investment, though commonly reported to be lower in developing than in developed countries, greatly understate actual rates of return for some companies.[25]

Although there are many reasons why a firm will engage in overpricing of imported intermediates and capital goods, the necessary condition for this to occur has been the establishment of tariff structures in some developing countries which provide high levels of effective protection to finished goods and correspondingly high potential monopolistic rates of return. Criticisms of this policy (as well as of the interrelated policy of generous tax holidays) imply that the foreign investor faces a given predetermined tariff structure, and in so far as this has attracted import-substituting foreign investments with adverse effects on the balance of payments, the developing countries have themselves to blame. To some extent, however, tariffs are a variable rather than a datum to the foreign

24 See 'Policies relating to technology of the countries of the Andean Pact, their foundations; A study by the Junta del Acuerdo de Cartagena,' (TD/107) 29 December 1971, pp. 16-17; TD/B/AC. 11/21, *op. cit,* pp. 56-59; 'Major issues arising from the transfer of technology: A case study of Spain' (TD/B/AC. 11/17), p. 51; Ghassen Salehkhou, *Commercialization of Technology in Developing Countries: Transfer of Pharmaceutical Technology to Iran,* Ph.D dissertation, New School for Social Research, New York, April 1974, pp. 192-211; and *Tax Treaties Between Developed and Developing Countries, Fourth Report,* (United Nations Publication, Sales No. E. 73, XVI) p. 143.

25. A calculation of declared profits plus royalty payments for 13 foreign-owned Colombian manufactuting firms averaged 13.1 percent of net worth for the years 1966-1970 compared with 52 percent when over-pricing on initial-firm imports was taken into account. Daniel Chudnovsky, *Foreign Manufacturing firms' behaviour in Colombia: A study of the influences of technology, advertising and financing upon profitability 1966-70,* Ph.D dissertation, Oxford University, 1973 cited in Keith Griffin, 'The International Transmission of Inequality,' *World Development,* March 1974, p. 14.

investor—a variable whose value is fixed during the course of bargaining and negotiations between the foreign enterprise and the host government. In these circumstances, the more powerful participant—typically the foreign investor, is able to influence the outcome in his favour.[26]

While there is less information available on the extent to which transfer pricing takes the form of undervaluation of the subsidiary's exports to its parent, the potential loss to developing countries in foreign exchange—particularly in industries based on the processing of primary products or in the assembly of manufactured goods within a vertically-integrated corporate structure, may be quite large and needs to be investigated. A recent case in Ethiopia came to the attention of the government only after a foreign-owned company wanted to expand its operations in the wake of a decade of losses amounting to nearly 14 times the original equity contribution. "The losses appeared improbable for the additional reason that the price of the commodity in question had shown a steady upward trend in the world market. Accordingly, a study was undertaken which showed that on conservative assumptions, the company was undervaluing its exports by 150 percent."[27] This type of practice may also be prejudicial to the country of the parent company by permitting evasion of tariffs. In the United States it led to an increase of $2.5 million in fiscal-1974 in the budget of the fraud unit of the Customs Service.[28] Unfortunately, few developing country governments have either the resources or the trained manpower to undertake comparable surveillance.

Because of the extensive control that transnational corporations exercise over world manufacturing markets, it is sometimes felt that association with them represents an avenue for export expansion. Indeed, limited

26 In Ethiopia it has been reported that '..... tariff guarantees constituted an integral part of the majority of agreements involving direct foreign investment; in some cases the investment and the technology transfer were made conditional upon such guarantees. Moreover, in the determination of tariff rates the Government has tended to rely heavily on data provided by the foreign firm itself.' (TD/B/AC/.11/21), *op. cit.* p. 20. See also International Labour Organization, *Employment Incomes and Equality : A Strategy for Increasing Employment in Kenya.* Geneva 1972, p. 439.

27 TD/B/AC. 11/21m *ibid.*, p. 57. Other instances in the same country are also cited in this study. Similar practices have been reported in Ghana, pertaining to a subsidiary exporting cocoa for processing to its parent in *Tax Treaties Between Developed and Developing Countries, op. cit.*, p. 112; and in Mexico and Singapore pertaining to intrafirm manufacturing exports, as reported by G.C. Hill, 'Customs Service Hits Multinational Firm for Export Violations : the Mexican Connection,' *Wall Street Journal,* November 6, 1974, p. 1.

28 G.C. Hill, *op. cit*, p. 1.

information on their export performance in developing countries does appear to indicate that although the exports of foreign-owned companies have been low in relation to their total sales, these exports do appear to account for a significant and growing proportion of total developing country exports of manufactured goods.[29] However, it has also been observed that for the most part the products exported have either involved light processing of local raw materials or the assembly of imported components.[30] Hence, in value-added terms the role of transnational firms in exports manufactures need not be more important than that of locally-owned firms.

A recent econometric analysis of 257 firms in Latin American countries provides further insight into the export behaviour of transnational corporations.[31] The results showed that firms with 90 per cent or more foreign equity exported substantially more to Latin America (but not to the rest of the world) than other firms but that there was no significant difference between joint ventures (defined as 10 to 90 per cent foreign-owned) and firms that were 90 percent or more domestically-owned. More importantly, the study indicated that firms selling predominantly to other units of the same parent company exported substantially less on the average to Latin American countries than firms exporting predominantly to unrelated buyers, and that the exports to the rest of the world of the two sets of firms did not differ significantly.[32] These results add further weight to the suspicion that the growing share of world trade between related affiliates of transnational corporations may be adversely affecting the balance of payments of developing countries.

Summary and Conclusions

The inflow of private foreign investment to developing countries rose to

29 *Review of International Trade and Development 1973,* ch. 3, *op. cit.,*

30 *Ibid.* See also B. I. Cohen, "Comparative Behaviour of Foreign and Domestic Firms," *The Review of Economics and Statistics,* May 1973, pp. 190-197, for an analysis based on South Korean firms.

31 The sample, drawn from Argentina, Brazil, Ecuador, Mexico, Paraguay, Peru, Uruguay and Venezuela, accounted for 25 per cent of the total exports of these countries combined in the period 1965-69. R. Muller and R. D. Morgenstern, 'Multinational Corporations and Balance of Payments Impacts in LDCs : An Econometric Analysis of Export Behaviour," *Kyklos,* Vol. XXVII, Fasc. 2, 1974, pp. 305-321.

32 The methodology, which is explained in the study, explicitly allowed for the effects of other variables including total sales, country of export origin, industry and productivity.

$ 5.8 billion in 1973, or nearly 28 per cent of all financial resource flows received from developed market economy countries and multilateral institutions. The political environment for transnational corporations in developing countries is influenced by the fact that one or two source countries typically account for half or more of the total stock of capital in each developing country. Because of the small, fragmented markets in these countries, it is not uncommon to observe whole industries in the manufacturing sector dominated by foreign capital. Adding to the concentration of foreign ownership is a persisting tendency by transnational firms to prefer majority or 100 per cent control and to enter a market by acquiring existing local enterprises rather than by creating new ones.

The awesome implications of the transnational corporations, both in terms of their importance in the world economy and in terms of their relations with developing countries, are partly reflected in statistics showing that some 200 of them have annual sales exceeding $1 billion. It is also seen in the oligopolistic markets in which they operate, in the relatively small number of such enterprises that are able to supply or control the lion's share of direct foreign investment and technology, in their considerable share of world trade, much of which is intrafirm and does not go through the market, and in their increasingly global perspective brought about by a hierarchical internal decision-making structure.

In the setting described above there exists no invisible hand of competition to insure that maximisation of global rates of return by the transnational corporation approximates to maximisation of the welfare of the countries in which they operate. Scattered evidence both on the over-all impact and on balance of payments effects of foreign investment increasingly suggests that these are often negative for the host country. At least three types of practices by transnational corporations tend to diminish their contribution to the balance of payment receipts of developing countries. These include the tendency to rely on sources of finance within the host country, the imposition of formal and informal restrictions on exports and sources of supply for their affiliates and independent licensees, and the over-pricing of exports to or under-pricing of imports from these enterprises.

Because of the extensive control that transnational corporations exercise over world manufacturing markets, it is sometimes felt that association

with them represents an avenue for export expansion. While this may be true in particular cases, the existence of export restrictions and under-pricing of exports mentioned in the preceding paragraph would certainly suggest that alternatives to such association should be given first priority. This conclusion is also strengthened by evidence of the low value-added of exports going through such channels and by the results of a recent econometric study of the comparative behaviour of a sample of 257 firms from eight Latin American countries, accounting for 25 per cent of the manufactured exports of those countries.

While this chapter has mainly considered the balance of payments effects of transnational corporations, it is clear that their impact spans virtually all areas of economic and social development. It is not surprising, therefore, that the Programme of Action on the establishment of a New International Economic Order addresses the problems which they pose in at least three sections dealing, respectively, with "Transfer of Technology", "Regulation and Control over the Activities of Transnational Corporations" and "Assistance in the Exercise of Permanent Sovereignty of States over Natural Resources". A variety of measures are envisaged. However, they all can be said to share the same two-fold objective : an improvement of the ability of each developing country to bargain effectively with transnational corporations on at least an equal footing and to pursue, if it wishes, national development policies involving alternatives to the transnational corporation.

Concrete action has already begun or is under way at various levels. It includes *inter alia :* at the national level, the steps taken by oil-producing countries and by some copper-producing countries to gain an increased share of the income derived from their natural resources and the enactment by Mexico and Argentina of new legislation regulating foreign investment and the transfer of technology ; at the regional level, Resolution 24 of the Junta del Acuerdo de Cartagena setting forth a common treatment for foreign capital, trade marks, patents, licensing agreements and royalties ; and at the international level, the possible adoption of a code of conduct on the transfer of technology, the possible revision of the international patent system, and the establishment of a permanent machinery to deal with transnational corporations within the United Nations framework.

Table 1 : Distribution of stock of foreign direct investment by DAC countries in developing countries, 1972

Regions, countries and territories[1]	*Stock of foreign capital end-1972*		*Foreign capital per capita US dollars*	*Present share in foreign capital by main investor country, 1967*
	US dollars (million)	*Percentage of area total %*		
1	2	3	4	5
Total, All Areas	48126	100.0	25	US. 50.4
Latin America	25835	100.0	92	US. 63.8
Brazil	6150	23.8	62	US. 35.6
Venezuela	3700	14.3	337	US. 73.1
Mexico	2650	10.3	51	US. 76.4
Argentina	2300	8.9	96	US. 55.8
British West Indies[2]	1800	7.0	1765	US. 42.2
Panama	1650	6.4	1086	US. 90.8
Jamaica	1100	4.3	573	US. 70.7
Trinidad and Tobago	1100	4.3	1048	US. 75.8
Colombia	910	3.5	40	US. 86.2
Peru	880	3.4	61	US. 84.4
Nerherlands Antilles	800	3.1	3478	US. 36.2
Chile	765	3.0	76	US. 91.3
Ecuador	350	1.4	54	US. 58.5
Dominican Republic	315	1.2	73	US. 81.1
Honduras	200	0.8	74	US. 97.7
Guatemala	190	0.7	35	US. 84.4
Costa Rica	185	0.7	101	US. 89.3
Guyana	135	0.5	180	Canada 41.0
Surinam	120	0.5	286	US. 56.7
El Salvador	100	0.4	27	US. 58.1
Nicaragua	85	0.3	43	US. 63.9
Uruguay	80	0.3	27	US. 71.5
Bolivia	75	0.3	14	US. 82.9
Haiti	55	0.2	11	US. 56.6
Belize	50	0.2	385	UK. 70.2
Paraguay	45	0.2	17	US. 57.6
French Antilles[3]	35	0.1	51	France 71.7
French Guiana	10	0.0	167	France 100.0

(*Table 1 Contd.*)

1	2	3	4	5
Africa	9404	100.0	28	UK. 30.0
Nigeria	2100	22.3	36	UK. 53.8
Libya	1560	16.6	78000	US. 77.7
Zaire	620	6.6	27	Belgium 87.8
Gabon	375	4.0	735	France 73.4
Liberia	360	3.8	224	US. 57.8
Ghana	360	3.8	40	UK. 59.1
Ivory Coast	340	3.6	75	France 80.0
Southern Rohdesia	315	3.3	55	UK. 88.3
Zambia	300	3.2	68	UK. 79.6
Angola	290	3.1	50	UK. 48.6
Algeria	250	2.7	16	France 71.7
Morocco	250	2.7	16	France 45.2
Kenya	235	2.5	19	UK. 78.8
Cameroon	210	2.2	35	France 75.1
Senegal	210	2.2	51	France 87.4
Tunisia	200	2.1	38	France 39.2
Guinea	175	1.8	43	US. 38.5
Mauritania	150	1.6	123	France 68.8
Mozambique	125	1.3	15	UK. 50.1
Egypt	100	1.1	3	U.S. 70.7
Congo	100	1.1	102	France 83.4
Madagascar	95	1.0	14	France 76.5
Sierra Leone	75	0.8	29	UK. 84.4
Ethiopia	70	0.7	3	France 43.7
Togo	65	0.7	31	France 56.6
U.R. of Tanzania	65	0.7	5	UK. 46.7
Malawi	55	0.6	12	UK. 92.7
Central African Rep.	50	0.5	30	France 91.8
Botswana	35	0.4	56	UK. 88.0
Niger	35	0.4	8	France 95.7
Swaziland	35	0.4	81	UK. 96.6
Sudan	35	0.4	2	UK. 74.9
Uganda	30	0.3	3	UK. 48.1
Dahomey	25	0.3	9	France 57.0
Chad	20	0.2	5	France 80.4

Table 1 (Contd.)

1	2	3	4	5
Burundi	18	0.2	5	Belgium 84.5
Upper Volta	18	0.2	3	France 75.3
Rwanda	17	0.2	4	Belgium 86.8
Somalia	15	0.2	5	Italy 83.3
Mali	8	0.1	2	France 76.9
Territory Afars and Issas	6	0.1	60	France 90.9
Gambia	5	0.0	13	UK. 87.0
Lesotho	2	0.0	2	UK. 60.0
West Asia	4051	100.0	55	US. 57.3
Saudi Arabia	1050	25.9	128	US. 90.4
Iran	1000	24.7	33	US. 45.1
Kuwait	725	17.9	863	US. 54.4
United Arab Emirates	250	6.2	1250	—[5]
Iraq	185	4.6	18	UK. 37.5
Israel	180	4.4	58	US. 59.8
Bahrein	170	4.2	773	US. 91.8
Muscat and Oman	110	2.7	157	Neth. 52.1
Lebanon	110	2.7	37	US. 54.5
Qatar	100	2.5	1250	UK. 40.5
Yemen, Arab Rep. of[4]	80	2.0	14	—
Syria	35	0.9	5	US. 56.8
Cyprus	30	0.7	46	—
Jordan	25	0.6	10	US. 75.0
Aden and Yemen People's Democratic Rep.	1	0.0	1	UK. 100.0
South and South East Asia[6]	8836	100.0	7	UK. 41.5
India	1660	18.8	3	UK. 64.6
Indonesia	1200	13.6	10	US. 73.2
Malaysia	1000	11.3	3846	UK. 74.3
Philippines	870	9.8	22	US. 88.4
Hong Kong	670	7.6	164	UK. 41.4
Thailand	490	5.5	14	US. 40.2
Pakistan	485	5.5	8	UK. 59.0
Singapore	485	5.5	226	UK. 33.8
Papua—New Guinea	435	4.9	167	—

Table 1 (Contd.)

1	2	3	4	5
Korea, Rep. of	360	4.1	11	US. 92.3
Brunei	190	2.2	1357	Neth. 56.1
Viet-nam, Rep. of	180	2.0	9	France 65.7
Sri Lanka	130	1.5	10	UK. 95.1
Khamer Rep.	85	1.0	11	France 88.2
New Caledonia	85	1.0	708	France 91.4
Bangladesh	55	0.6	1	—
Afghanistan	16	0.2	1	US. 54.2
Burma	10	0.1	0	UK. 92.8
Laos	8	0.1	3	France, US. 36.6
Nepal	5	0.1	0	US. 50.0

Notes : [1] Countries and territories are arranged within regions in descending order of state of foreign capital.

[2] Includes Leeward and Windward Islands, Bahamas, Barbados and Bermuda.

[3] Martinique and Guadelupe.

[4] 1971 data.

[5] Abu Dhabi . . . . U.K. 51.2%; Dubai . . . . U.S. 46.2%.

[6] Including Oceania.

Sources : Development Assistance Directorate, Organisation for Economic Cooperation and Development, *Stock of Private Direct Investments by D.A.C. Countries in Developing Countries—End 1967*, Paris, 1972

—End 1972, Paris, 1974

United Nations, *Monthly Bulletin of Statistics*, October 1974.

Table 2: Manufacturing Subsidiaries in Developing Countries of 396 Transnational Corporations : Characteristics of Ownership and Methods of Affiliation

	Subsidiaries of 187 transnational corporations[1] based in the United States		*Subsidiaries of 209 transnational corporations based elsewhere than United States[2]*		*Total*	
	Number	*Percentage*	*Number*	*Percentage*	*Number*	*Percentage*
Ownership characteristic[3]						
Wholly owned	669	42.2	323	19.1	992	30.3
Majority-owned	258	16.3	377	22.3	635	19.4
Minority-owned	450	28.4	649	38.4	1099	33.6
Not classified	207	13.1	340	20.1	547	16.7
Total	1584	100.0	1689	100.0	3273	100.0
Methods of affiliation						
Acquired as going business	870	54.9	991	58.7	1861	56.9
Newly created	567	35.8	476	28.2	1043	31.9
Not classified	147	9.3	222	13.1	369	11.3
Total	1584	100.0	1689	100.0	3273	100.0

Source : Industrial Development Survey : Special issue for the Second General Conference of UNIDO, (United Nations Publication Sales No. E. 74.II.B. 14), p. 194.

[1] Data cover period to 1968.

[2] Data cover period to 1970.

[3] At time of establishment.

Agricultural Technology Transfer

Robert E. Evenson

A simple view of the transfer of technology from one region to another involves a sequence in which new technology is produced and is then diffused or adopted by producers. Typically producers in one or more regions will adopt the technology ahead of producers in other regions. Thus the term "transfer" is applied to adoption patterns and is often treated as implying something more than simple adoption in which producers "screen" alternative technologies and select profit maximizing technologies (subject to constraints).

Simple Technology Diffusion

Some useful insights can be gained into the more general process of technology transfer by considering features of simple diffusion. Suppose that an initial equilibrium exists in which farm firms have selected from among a wide range of alternatives those technologies which are profit maximizing. It is observed first that producers in agriculture will almost certainly not be utilizing identical technologies in equilibrium. It is one of the corner-stones of production and cost theory that firms facing different factor prices will not choose the same technologies. They will be at different points on the isoquant. It is probably true that some parts of the technology set will be quite similar but firms will select technologies to minimize costs and this means that they will differ in some respects in production technology unless, of course, it is impossible to substitute one factor for another.

This same principle applies to environmental factors other than prices. Even if all farmers in an Indian district faced the same output and factor prices (they do not) they almost certainly would not select identical technologies for producing a particular crop such as wheat. The reason for this is that they face different environments with respect to soil and climate factors. And most agricultural technology is very *sensitive* to these factors. It is not unusual to see many varieties of the same crop being planted in small regions. This is because the varieties differ with respect to their relative superiority under differing environments.

An equilibrium is thus characterized by the utilization of technologies which are suited to, or "tailored' to, environmental "niches". (In the following section, the incentives to develop such tailored technology is discussed).

Now consider the development of some relevant new technology, say a variety of wheat. The new technology in the initial stages has some uncertainty about it. In particular, there will be uncertainty about the range of existing technologies which are now economically *inferior* to it (i. e., have higher average costs per unit output in equilibrium). It is a rare technology indeed which turns out to render all existing technologies inferior to it. This is so, because of the fact that agricultural technology is tailored to environmental niches and improvements are likewise tailored. Only truly extraordinary new technologies such as the early "Mexican" wheat varieties introduced to North India in the mid 1960's render existing technology inferior over a wide range of environmental conditions. (It might be noted here that extension workers and researchers with vested interest in the diffusion of technology usually greatly over-estimate the extent of superiority of new technology).

The process of diffusion of this new technology is fundamentally a matter of the economics of learning and experimenting by farmers. Farmers have an incentive to experiment with new technologies as long as they are being produced. This involves "screening" or "scanning" communications of several types for information about new technologies and on farm testing and experimentation. Farmers differ considerably in their ability to systematically screen and experiment and information supply agencies such as extension workers and farm supply agents (fertilizer, insecticides, etc.) differ in terms of the degree and quality of information provided for farmers to screen.

The result of this behaviour will produce certain diffusion patterns. These patterns will be related both to farmer characteristics such as age, schooling, size of farm and availability of family labour and to environmental factors. For given enviromental condltions, many studies purport to show correlations with farmer characteristics and rates of adoption of technology. These studies are often faulty on two grounds. First, they often do not really control for changing environmental conditions and secondly, they often provide little in the way of a theoretical foundation for their correlations. They tend to focus on the obvious cases where

the new technology is superior to the many cases and neglect them, whereas the farmer screening and experimentation show that it is not.

For the cases of obvious superiority, one can take the findings of these studies as showing that education creates screening and experimenting capability in producers and that larger farms have incentives to do more screening and experimenting. It is also clear that the greater the economic superiority of the new technology, the less screening and experimenting is required to determine whether adoption is profitable.

In diffusion studies which do not specifically take environmental factors into account, quite erroneous and spurious relationships can be obtained. Very often the failure of farmers to even devote resources to screening and experimentation is simply due to the fact that there is a very slim chance that the new technology is really superior in his niche. And producers who have not enjoyed appreciable new technology for a long period of time are unlikely to devote many resources to look for it.

Transfer Process : Diffusion of Knowledge

Simple technology diffusion patterns are determined both by farmer characteristics and by the sensitivity of technology to environmental factors. They involve only simple screening and experimenting. Transfer involves a "disclosure" effect, followed by adaptive research. It too is limited by environmental conditions. Thus, patterns of technology transfer will depend on farmer characteristies, environmental characteristics and *research effort* directed to the production of closely related technology. We first note that for technology transfer, as opposed to technology diffusion it is required that research capability be developed which has the objective of producing new technology suited to different environmental conditions. Some of this research capability will reside in inventive farmers and blacksmiths. Historically, most farm inventions and plant and animal improvements were made (at a slow pace) by men and women without scientific or engineering training. Most new biological technologies today do require scientific training and, to a lesser degree, engineering training is required for mechanical technology development. So what is really being talked about is public sector agricultural experiment stations and private input supply industries.

Now consider the transfer process. A new technology is developed. It is a superior technology only in a limited number of environmental niches and in those niches a simple diffusion process will be initiated. The technology, however, also provides a disclosure of knowledge to researchers consumed with these and "nearby" niches which may enable them to make a related discovery. The case of genetic material, for example, has such an effect. A breeder may select a cold tolerant variety which is suited to certain niches, but he or other breeders will upon disclosure of the success in breeding the first variety be able to redesign their own breeding programme (perhaps by using the cold tolerant variety as a parent) to produce cold tolerant varieties adapted to other niches.

Strictly speaking, technology is not transferred, it is only diffused. The transfer is of knowledge which forms a "building block" in further technology development. Such knowledge is diffused in varying form and by different means of communication. Some knowledge is disclosed by the characteristics of the machine or other form of tangible embodiment of the technology. Some must be communicated in abstract form as in patent claims or scientific papers. In agriculture, particularly in the biological sciences, much knowledge is diffused through genetic material.

From the perspective of the researcher with the objective of developing new technology there are two primary sources of new knowledge of relevance to his task. One is disclosed by the development of new technology, and the other is by new knowledge which is not actual technology. It is the former, which is being considered to be a part of technology transfer. The latter might be termed as knowledge transfer. Of course, researchers may also benefit from acquiring knowledge which is not new in the sense meant here.

The nature of the screening and experimenting undertaken by the researcher is basicallysimilar to that undertaken by the producer. It differs in degree, however, requiring finer skills and more in-depth understanding of the physical and biological phenomena involved. if the skills of the researcher have not been acquired by significant numbers of people and institutions have not been developed to enable efficient research conduct in a region, that region will be unable to benefit from technology transfer. It will only have the option of technology diffusion.

Studies of Agricultural Technology Transfer

In contrast to the many studies of technology diffusion within small geographic regions, very few studies of international technology diffusion or of international technology transfer have been undertaken. A study of the history of varietal transfer in sugarcane (Evenson, Houck and Ruttan, 1969) Illustrates many of the features of technology transfer discussed here.

In the sequence of major developments in sugarcane varietal transfer, the earliest improved varieties were produced in a small set of experiment stations which were established prior to 1900 As the first new varieties were discovered in the stations in Java and Barbados in the British West Indies, (and India, Mauritius, and Hawaii somewhat later) they were actually diffused quite rapidly to producers in many parts of the world. The simple screening activities of the cane growers proved inadequate in most countries, however. The new varieties were susceptible to diseases in many new environments and as a consequence, producers were forced to abandon them and return to the traditional varieties.

In fact, the screening activity ultimately required very systematic field testing, and understanding of the various cane diseases and the development of methods of testing varieties to determine disease resistance. Sugarcane producers generally did not have the skills required to undertake this type of screening. In many countries (e.g. South Africa) the widespread incidence of diseases associated with new varieties led the growers to completely ban the growing of the new varieties in the interest of controlling disease in the native varieties. The incentives to establish experiment stations in every country was now based on two objectives. Not only could the stations undretake a varietal research programme, but they could also undertake the screening which had proven to be too difficult for the growers.

In the early 1900's, a number of experiment stations in South Africa, Mexico, Agrentina and Australia and several other countries were established to pursue these objectives. They were generally successful in doing so. During the 1920's and 1930's these stations performed an important screening function. They screened varieties suited to the environmental conditions faced by their growers and facilitated diffusion of the new varietal technology internationally. Their research

programmes in agronomy and cane breeding were also dependent on their ability to screen national and international genetic material and genetic and agronomic knowledge from other countries. The leading experiment stations (particularly, those in Java and India) then produced a new set of interspecific hybrid varieties in the 1920's and 1930's which were rapidly diffused to countries with screening capability. By the late 1930's and the 1940's the cane breeding programmes of the new domestic varieties which were developed and adapted specifically to domestic environmental conditions proved to be superior to the internationally available varieties. The indigenous research programmes thus facilitated the transfer of the technology developed in Java and India.

The sugarcane experience in the 1930's was a forerunner of the modern "green revolution" wheat and rice varieties. As with the interspecific sugarcane hybrids of the 1920's and 1930's the dwarf wheat hybrids from CIMMYT and the dwarf rice varieties developed at IRRI and elsewhere were initially diffused over wide environmental conditions. That diffusion was closely related to the research capacity of the countries which borrowed the new technology. Furthermore, there was significant knowledge transfer through the adaptive reseach of the borrowing countries.

A study of productivity in wheat and maize (Kislev and Evenson, 1973) was one of the first to explicitly deal with environmental factors. The basic procedure utilized in the study was to first define geo-climate regions. The classification of Papadakis (1966) was modified to the purpose. The model of the study then postulated a relationship between yield changes over time in a country and the stock of research capital (a measure of research intensity) both in the country and in similar regions in other countries. Thus the model postulated that a country could indeed benefit from (or borrow) research done in the other countries, but only if the environments were sufficiently similar.

The study concluded that a high degree of complementarity existed between research capability and the extent to which a country actually borrows technology or knowledge. In fact, the implication of the data was that in both wheat and maize production, if the borrowing country did not have indigenous research capability, it realized or borrowed, only a tiny fraction of the gains possible with research

capability. The marginal gains to the country conducting research were approximately as high from the facilitation of borrowing as from the discovery of technology suited to the country itself.

A further study of productivity in cereal grains production (Evenson, 1974) was based on a similar model, but with somewhat more detailed data. The model was more flexible regarding the complementarity between research in different countries. The model also incorporated the recent high-yielding varieties discoveries as semi-exogenous factors. The conclusions reached in this study were :

(1) That indigenous research activity complemented borrowable research at low levels, but was a net substitute at high levels.

(2) Environmental factors matter, both in the diffusion of technology and in the diffusion of knowledge or transfer of technology (albeit to a lesser extent). Very little knowledge diffusion across major climate regions takes place. In cereal grains the diffusion from developed to developing countries has been almost nil.

(3) That the green revolution high-yielding varieties represented a departure from the normal pattern of technology discovery, but only temporarily. Today the high-yielding varieties are as much the product of national research systems as of the international centers.

(4) That investment in research in developing countries yields a higher payoff than in the developed countries, and that research devoted to discovering new knowledge is probably of higher economic value than adaptive research.

(5) That the "typical" investing country appropriates a relatively small share of the total gains from research in the developing countries. A country without research capacity realizes very little benefit from the research of neighbours, however.

We are only beginning the systematic study of the technology transfer process. These studies have only begun to identify the complexities of the process. It is important, however, that we develop improved conceptualization and improved empirical base for designing policies to facilitate both technology diffusion and technology transfer.

REFERENCES

1. Evenson, R. — "International Transmission of Technology in Sugarcane Production," Mimeo, Yale University, 1969.

2. Hayami, Y & Ruttan V. — *Agricultural Development : An International Perspective.* Baltimore, Johns Hopkins Press, 1972.

3. Houck J., Ruttan V. & Evenson, R. — "Technical Change and Agricultural Trade : Three Case Studies, Sugar, Bananas and Rice," in Vernon, R., (Ed.) *The Technology Factor in International Trade,* National Bureau of Economic Research, 1969.

4. Kislev, Y & Evenson, R. — "Investment in Agricultural Research and Extension, An International Survey," Economic Growth Centre Discussion Paper No. 141, Yale University, 1971.

5. Kislev, Y & Evenson, R. — "Research and Productivity in Wheat and Maize, *Journal of Political Economy,* 1973.

6. Latimer, R & Paarlburg, D. — "Geographic Distribution of Research Costs and Benefits", *Journal of Farm Economics,* 47, 234-241.

7. Mohan, R., Jha, D. & Evenson R. — "The Indian Agricultural Research System," *Economic and Political Weekly*, Bombay, March 1973

8. Papadakis, J. — *Agricultural Climates of the World,* Buenos Aires, 1966.

Implementing Appropriate Technology Programmes

Ram K. Vepa

There has been considerable discussion in the last decade on the need for Appropriate Technology to stimulate faster economic growth in developing countries. Propounded originally by Dr. Schumacher as "Intermediate" technology to correspond to the stage of development of these countries, the concept is now seen to have a much wider scope in many areas of national life. In order, however, that the stigma of second rate technology does not apply today—which makes it unacceptable to countries that still carry memories of colonial legacy—it has been re-designated as "appropriate" technology, to conform more closely to its basic theme that technology should be relevant or appropriate to the environment in which it operates.

Appropriate Technology *vis-a-vis* Developing Countries

Many countries, both in the developing and developed countries, have been actively working in this area. India was one of the first to recognise the need for it ; in the draft outline of the Fourth Plan issued in 1969, a specific reference was made to the need for adopting this approach to many problems. An Appropriate Technology Cell was set up in 1971 under the Ministry of Industry, and although, the efforts of this organisation have been considerably handicapped due to lack of resources and personnel, it has served to stimulate interest amongst a wide variety of personnel and initiate work in a number of areas by bringing together workers from diverse disciplines. In Indonesia, the Bandung Institute of Technology, in collaboration with the East-West Centre, Hawaii, have been operating a programme to identify areas which are suitable for the development of appropriate technology. The Korean Institute of Science and Technology has also been doing some useful work in this direction. In many African countries, there has been interest in this programme which has been undertaken with international assistance. An Intermediate Technology Development Group (ITDG) founded by Dr. Schumacher himself has been working in the countries of Africa, developing new techniques and implements which are considered suitable for those countries. The Volunteers for International Technical

Assistance (VITA) which is a non-profit organisation in United States is also setting up affiliate units in other countries such as Philippines in order to encourage transfer of technology on a person-to-person level. International organisations like UNIDO, ILO and FAO have shown growing interest in this concept. The UNIDO has set up an Appropriate Choice of Equipment (ACE) programme which advises clients in developing countries on the choice of appropriate equipment, while the ILO has been operating an Appropriate Technology Centre in Tanzania for some time.

Despite all the above efforts, there is still incomplete appreciation and understanding of the way Appropriate Technology needs to be implemented. While, conceptually it has been accepted as being of significance to developing countries, there is inadequate understanding of the manner in which appropriate technology needs to be practised. Few countries have had the courage as yet to integrate this concept closely into their day to day policies. It still seems as an idea which is fit to be discussed at Seminars and Conferences but does not have an immediate practical relevance. Policy makers in developing countries are still somewhat unsure themselves to be able to go ahead with boldness and vision with programmes based on appropriate technology. The reasons for this diffidence are many, some of which are discussed here.

(*i*) *Criteria of Appropriateness :* One of the basic difficulties about appropriate technology which most people have is the purely semantic one : how does one determine which technology is appropriate ? What are the basic criteria to be applied in judging appropriate technology ? Can this characteristic be quantified ? To answer these questions by merely saying that appropriate technology is that which is "appropriate to the country or society concerned is merely to indulge in tautology. There is need for quantifying parameters or indicators which would determine, to some extent at least, the degree of appropriateness of a particular technology to the conditions in a society. This is a matter for economists and administrators to work together so as to arrive at simple criteria which could be applied to any particular technology to determine its appropriateness. Perhaps, the employment provided by the technology or the value added by the worker or the total productivity of the operation may be indices which could provide some idea whether a particular technology is appropriate or not. In the ultimate analysis, the

whole concept of appropriate technology is significant only because it is expected to optimise the use of resources, both human and material, but this characteristic must be quantified into a single index of appropriateness which could be applied by the administrator and the policy makers at all levels when faced with an actual choice. Unless such an attempt at quantification is made, appropriate technology will remain a beautiful "idea" but difficult to practise.

(*ii*) *Availability of Know-how :* Another important bottle-neck in the wider application of appropriate technology is lack of adequate information on the availability of know-how. It must be confessed that since this problem is peculiar to the developing countries, not much work has been done, or will be done in future, in the developed countries. It is for the developing countries themselves, assisted by interested international organisations, to undertake the major technological thrust that will expand the horizons of appropriate technology. It should not always be regarded that this is scientifically or technologically speaking a minor effort. On the contrary, it might involve the application of some of the latest scientific principles to arrive at the most suitable technology for a particular country. It will, therefore, require the combined efforts of a variety of disciplines in science itself and should be considered as a major priority for any first class research institution.

Unfortunately, in most countries the scientific effort is largely patterned on that which is being done in the advanced countries. Partly, this comes out of a vague feeling that such a programme is modern and helps to "keep up with the Joneses". Partly, it comes out of the familiarity of the top scientific personnel with the work being done in these countries. Whatever the reason, it is time for technologists in developing countries to be reminded, as Lord Blackett once did, that there is no greater or more urgent tasks for these persons than to attend to the problems that lie in their countries, practically in their backyards. "In most parts of Asia", said the distinguished Nobel laureate, "the problem really is to devise new technologies which make manpower more efficient without much capital expenditure." There is, therefore, need for undertaking more intensive technological research into the problems of the developing countries, which may sometimes seem somewhat less glamorous or exciting at a time when the scientific world is preoccupied with space shots and landing on the moon. But in their ultimate result such work is bound to have much greater impact on

the growth of the country than problems which are of no immediate relevance. As Julius Nyerere, the wise leader of Tanzania has said, "while other countries aim to reach the moon, we must aim, for the time being, to reach the village".

(*iii*) *Ready Information :* Even where technology is available, there is not always adequate data on it to be applied readily. In fact, one of the major tasks of any international organisation is to operate a "data bank" which can collect information on the developments that have already taken place in many of the less advanced countries. This could then, in turn, be fed to other developing countries which are placed in a similar situation. Such sharing of experience amongst the developing countries themselves is likely to be more meaningful and more beneficial than the sharing of knowledge with the more advanced countries who are so far ahead that their research is of no immediate significance to the problems of the developing world. What happens in India or Philippines may be more relevant to other countries of Asia and Africa, than the developments in USA, U.K. or even Japan.

The Small Industries Extension Training Institute at Hyderabad is operating a documentation centre for small industry, including appropriate technology and their quarterly bulletin provides information on developments in this field. The Vaikuntlal Mehta Smarak Trust, a non-profit organisation at Bombay also publishes an abstract survey every quarter on appropriate technology. Such efforts would need to be organised on a wider footing so as to embrace various sectors which are of importance to appropriate technology. The data so obtained at the national level can be pooled together at the international level for suitable exchange of information. The Intermediate Technology Development Group in U.K. publishes a monthly Bulletin under the title *Appropriate Technology,* providing a useful forum for sharing of information. Similarly, the *News Letter* and other literature published by VITA also gives information on the work being done in institutions and laboratories around the world. There is, however, need for a more systematic and organised effort to collect information so that technologists and policy makers become aware of the choices available to them, limited as they are. Very often the lack of such information is proving, particularly, a big handicap for building appropriate technology into specific programmes.

(*iv*) *Indigenous Manufacturing Capacity :* Even if a particular product is

developed in the laboratory, it needs to be produced on a large scale if it is to have a mass application. Unfortunately, the fabricating and design capabilities available in the developing countries are not always adequate for this purpose. The large scale sector in these countries is based primarily on techniques and processes developed in the Western world, since much of the industry has been set up in collaboration with leading manufacturers in these countries. There is, therefore, a reluctance to undertake fabrication of the comparatively simpler developments that are envisaged in appropriate technology.

The ITDG, had compiled a catalogue some years back, entitled 'Tools for Progress', giving details of simple equipment and implements which are available on a commercial scale for users in developing countries. It may, perhaps be useful for some of the State promotional organisations such as the Industrial Development Corporations or the State Agro-industries Corporations to take up this work and produce on a large scale improved implements and equipment which can be distributed widely in the rural and semi-urban areas of the country. Unless such a manufacturing capacity is developed, mere development of a technology in the laboratory is not likely to produce the desired impact. This is one of the key weaknesses in the developing countries where the work in the laboratory does not have an immediate relevance to the industrial growth of the country. This can be bridged only by the State promotional organisations which have been set up in every part of the country and which can take up production on a large scale of items that are suitable to the conditions in their own State.

(v) Administrative Procedures : Another bottleneck in the widespread application of appropriate technology is the outdated administrative procedures which continue to hold sway. In the building and road construction, for instance, the long-established Public Works Department has procedures which are based on the principle of the "lowest tender", other things being equal. The rules themselves are not too rigid and do provide for the acceptance of a tender which is higher than the lowest, if there are tangible benefits which flow from the acceptance of such a tender. Unfortunately, few administrators, particularly, at the middle levels are willing to take the responsibility for chosing a tender which is higher than the lowest; most often, they accept a tender which uses the most machinery, ignoring another which is likely to employ more labour and less machinery. It is the latter that will produce in the long run

results with a higher social benefit to the community but the administrators feel helpless in the matter since the rules, they say, make it almost obligatory for them to accept the lowest tender.

It may, perhaps be necessary in this connection to quantify an index which would provide a measure of the social benefits, appropriate technology can provide to a community. Such a measure could depend upon the quantum of appropriateness which has been discussed above. Alternatively, as has been done in the case of Small Industry, it may be possible to have a rough and ready index which could be used to give weightage to appropriate technology against those which are less appropriate. In the case of the small scale industry, it has been stipulated that any product made in that sector should be given weightage upto 15% in deciding a purchase tender; a similar quantification of the social benefit of appropriate technology may make it possible for such a technology to be used on a much wider scale.

(*vi*) *Cultural Orientation :* It has already been stated above that one of the important problems is the cultural orientation of the technologists and policy makers. Most technologists have been schooled in Western universities, and are, therefore, reluctant to work on programmes which to them seem less than the best. Similarly, policy makers are so tuned to Western concepts that the idea of employing a semi-modren technology seems to them to smack of a colonial feeling. There is need for a greater recognition that in the circumstances prevailing in the developing countries the most modern is not always the best and that the most appropriate could well deliver the goods better than what generally passes as the most modern technology.

Perhaps as years go by and policy makers and technologists in these countries acquire self-confidence, it will be possible for them to break away from the strangle-hold of Western ideas and concepts which prevail in many developing countries. It is for this reason that even in India, which is certainly one of the most developed of the developing countries, there is a hesitation to employ processes tried in the laboratory; the Vertical Shaft Kiln Cement Plant, for instance, which has been developed at Jorhat in Assam is yet to find a practical application, although conditions in the North East Region itself are suitable for this purpose. But to take such a decision involves self-confidence on the part of the technologists themselves and boldness on the part of policy makers, both of whom

tend to feel inhibited due to the 'Western' orientation in their attitudes.

(*vii*) *Inadequate Rural Bias :* Part of the difficulty is the fact that rural problems do not always get the attention they deserve at high policy-making levels. Most scientists and technologists are urban oriented and hence have inadequate understanding and appreciation of the problems of the rural areas. The same is the case with the administrators except those who have had some familiarity in dealing with the people in the country-side. But even in their case, such an experience comes almost at the beginning of one's career and, subsequently, there is hardly any opportunity for the officers to 'recharge' their understanding of rural problems. Perhaps, as has been done in the case of Castro's Cuba or Mao's China, it may be desirable to insist that every public official—whether a scientist, technologist or an administrator—should work for a minimum period of two weeks every year in a village so that there is a renewed understanding of the problems and the parameters of the rural areas. It is only through such knowledge that one can arrive at techniques and processes which are more relevant to such areas than to the purely urban regions in which most of the scientists and administrators live.

(*viii*) *Foreign Technology :* The many collaborations which indigenous industry in developing countries has made with foreign companies has lead to the markets in these countries being familiar with brand names and products of the western world. Names such as Coca Cola, Ovaltine, Horlicks or more recently the Japanese brand such as National, Cannon, Honda, and Sony have become household words all over the world. It becomes, therefore, doubly difficult for indigenous groups to break into this monopoly of the foreign industry collaborating with indigenous groups within the country. India has taken a stand in recent years that even where foreign collaboration is agreed to, it should be based only on advanced technology and that brand names, particularly, for consumer goods would not be allowed in the internal market. It is necessary that greater vigilance is exercised in regard to import of foreign technology so that markets within the developing countries are not completely monopolised by such interests.

Only China has had the courage in the last two decades to build appropriate technology into their programmes, although it is not so called by their policy makers. China has followed in agriculture a policy of what they call 'semi-mechanisation', which uses improved implements without

going over to large scale mechanisation. In their irrigation programmes, they have used large number of people to build vast irrigation projects as well as flood control dams. In industry they have consistently employed the "walking on two legs theory", whereby both the small and large industries are expected to contribute to the national life. In recent months, however, there has been a tendency in that country to break away from these concepts and to concentrate more and more on high technology areas. This again is the result of the fact that using appropriate technology, the country has been able to come up to a certain level of economic growth which, in turn, enables it to take appropriate technology to a higher level. Even the much publicised "backyard furnaces" of the mid-fifties which were being ridiculed by Western technologists and the press are now seen, in retrospect, as having made possible the production of steel which could be utilised for low grade applications; with steel production running today at about 25 million tonnes, China seems to have no more use for such furnances and has switched over to large scale steel plants. The application of appropriate technology, therefore, requires a policy of pragmatism and flexibility and a willingness to concede that different conditions may require different solutions and techniques.

Conclusion

The fact that India is a vast and diversified country offers excellent opportunities to technologists and policy makers to try different 'solutions' within the country and acquire valuable experience which can be employed in other parts of the country. Appropriate technology requires a bold and pragmatic approach to the problems as well as a significant modification of existing attitudes and procedures. It is only then that it can produce the desired impact on economic growth of the community; otherwise, it is likely to remain as a 'hardy annual' for discussions at seminars and meetings but seem to be of little consequence in devising practical solutions to the problems of developing countries. With its technical skills and manufacturing capabilities, India can well be a pace setter in this field and an "exporter" of appropriate technology to the third world.

Appropriate Technology for India

M.S. Iyengar



The task of technology is to bring about social change. The introduction of the plough transformed the society from hunting to agriculture. The food surpluses resulting from agriculture and the solution of the connected problems provided the basis for specialisation of labour, writing, city, social classes, the state and civilization as we know it. It also was responsible for the first great population explosion in human history. The stirrup and the horse-shoe made feudalism possible. The compass led to the discovery of sea routes to India and eventually to the colonial era. The discovery of the steam engine coupled with the capital accumulated from the plunder from the colonies resulted in the Industrial Revolution. Atomic energy, electronics, space satellite, cybernation are now transforming the affluent societies into post-industrial societies.

Historically, technology created new resources or helped to exploit the traditional ones, but in most instances it tended to be tied down to its physical resource base. Major industrial centres were built around coal-iron ore belts. The advent in chemistry and progress in transport has made most of the industries "leg-free". A notable example is Japan which without its own iron and coal resources has become an exporter of steel. Availability of superior technology—and not the location of raw materials—has become the principal factor in the emergence of new industrial centres and the economic viability of nations and regions.

Integrative Effect of Technology

The independence of technology from resource base has resulted in two levels of integration. One level is the integration of human activity and spatial unit into one global geo-technical system.

The advanced industrial societies are highly inter-related technologically and politically. The communication satellite promises to envelop the developing regions also and integrate them with the developed world.

The other level is the large-scale integration which is proceeding in science and technology itself. The combination of computer, satellite and atmospheric sciences open up new vistas for weather prediction and modification. The combination of electronics and chemistry, chemistry and biochemistry is producing synergistic breakthroughs in the life sciences.

All these things are making technology complex, costly and global. Even in such conventional itmes as transformers for power network, the economics of scale is pushing producers into co-operation or merger. Even giants like Siemens and Telefunken are forced to join hands in the heavy electrical engineering field. Complex technology demands system approach. With increase in the scale of operation, the commitment of time and money become inflexible. It also calls for specialised manpower and complex business organisation and industrial planning. Not only the enterprise needs to exercise control over what is sold but also over what is supplied. The larger the scale of operation, the larger would be the time taken for its completion. Therefore, sophisticated methods of planning, including technological forecastings have to be adopted.

Science-based Industry

India has tended to model its development on the Western pattern of industrial growth. If it is to follow this logic to its natural conclusion, it will have to make its science and technology much more sophisticated and opt for science-based industries. For instance, like Japan, it will have to shift from the throw-away industries like coal, paper and pulp, non-ferrous metal, agricultural products to third stage industrialisation like automobile, precision tools, large scale construction equipment, computer, electronics etc. In that sense, our attempts in harnessing of atomic energy for peaceful purposes and launching of Aryabhatta in space are in the right direction. Nuclear agro-industrial centres for de-salination of water for irrigation purposes with large-scale production of chemicals, fertilizers and metals from sea water and air could provide to millions of people new sources of food and equipment. Space satellite could facilitate discovery of new mineral resources and generate economic activities in geographical regions hitherto considered uneconomical. In August, India will be launching an experiment to provide

audio-visual television programme through space satellite to 2,500 villages. This would demonstrate that a satellite-based TV network could be built and made operational in about 4 years. To construct a comparable conventional TV net-work would take perhaps as long as two or three decades and the cost would be twice as great. Education/communication through space satellite, therefore, becomes 'appropriate' to Indian conditions. Adoption and reliance on electronics also is 'appropriate'. Adoption of large-scale integration in place of thermionic valves or transistor could increase the performance of radio receivers and make them more accessible to the common man. Option for developing micro-computers in preference to traditional computers again would be appropriate because the latter would tend to decrease the cost by several-fold and make it available for a multiplicity of uses.

One of the imperatives of technology, however, is that it tends to eliminate manpower. This, in a developing country like India would mean more unemployment. The last 28 years of industrial development has indicated that industrialisation and increase in Gross National Product does not automatically increase the standard of living. In fact, the disparity between the rich and the poor has widened considerably. Consumerism leads to higher import content and increase in the production of such goods aggravates rather than alleviate the problem of balance of payment. It is in this context that the approach to the Fifth Plan worked out by the Planning Commission becomes relevant. The approach analyses two possible patterns of growth. The first is based on the perpetuation of the present patterns of distribution of income and of consumption expenditure and the second upon a radical redistribution of consumption expenditure in favour of 30% of the population below the proverty line. The first approach leads to preservation of a dual society and the second to a reduction in inequalities.

Appropriate Technology

The magnitude of the problem faced by India can be appreciated from the following. By the turn of the century, the population would have doubled and the food production would have increased 2.5 times; the clothing requirements would have increased to 25 million metres involving an expenditure of Rs. 8,000 crores. Power consumption would

have to be increased to 214 million kilowatts and steel production to 75 million tonnes and even if this is done, India would still continue to have all the disparities of the present day reality. India would, therefore, have to not only opt for sophisticated technology and industry but also simultaneously opt for appropriate technologies, i.e. technologies which are more labour and less capital intensive and which could be made operational within a short period utilising local talent and local raw materials. Such industries will have to be low-energy based. The arguments in their favour are:

(i) Low capital and capacity to utilise abundantly available labour;

(ii) Capital-intensive technologies become efficient only when operated on large scale but the market is small and more in favour of scale-down ;

(iii) The divisible nature of the investment is in favour of small units ;

(iv) They can spread easily and increase links with the rest of the economy more readily than a few large units in isolated areas;

(v) Because of their labour-intensive nature, appropriate technologies can ensure more wider spread of benefits of growth;

(vi) The low capital and low gestation period can make for a high rate of growth in the economy with no drain on foreign exchange ;

(vii) They make more ready use of local raw materials and their operations meet with less maintenance problems.

The arguments against them are :

(i) Labour intensive technologies tie down the capital longer and take longer time to mature.

(ii) They demand more enterepreneurial skills which are scarce.

(iii) They make a non-human use of human beings.

Notwithstanding these valid criticisms, the fact remains that appropriate technologies can bring about social changes more rapidly in the rural areas with less time, energy and effort than can capital-intensive technologies. In any case, their role is transitory and relevant only till such time as the economy takes off.

The following examples illustrate the possibilities of adopting alternative technology :

(*1*) *Mini Cement Plant.* The Indian Cement Co. started production of cement in 1914 with a capital perhaps not exceeding Rs. 100,000. The time taken by them to go into production was not more than six months. Today, the installation of a 5,000 tonnes-per-day capacity jumbo kiln will call for a minimum investment of Rs. 450 million, the time taken for its installation being not less than 2 years. Operation of such a plant wolud call for specialised manpower and a complex business organisation with control not only over the market but also over uninterrupted supply of power, raw materials and specialised skills. These conditions do not exist at present in India. Although, in the past, cement industry had installed bigger capacity units, the performance during the last few years has shown that the installed capacity utilised, which in 1968 was 94%, has been gradually decreasing and during the first half of 1974, it decreased to 69% mainly due to the deterioration in the power and raw material supply. The price of cement has been increasing correspondingly. The investment cost has increased from Rs. 101 per annual tonne in 1957 to as much as Rs. 600 in 1974. While in theory, installation of jumbo rotary kiln would be more economical, in actual practice it will lead to a decrease in productivity and increase in cost of installation and production. Also, for a large country like India where consumer centres are distributed over long distance, what is saved as initial capital cost would largely be negated by long haulage cost of the finished product. The alternative would be the installation of several mini vertical shaft kiln cement plants, for which the technology is indigenously available. These kilns can be operated continuously, having the following features :

(i) The feed is in the form of uniform nodules ;

(ii) Since the raw meal has the fuel interground, fuel efficiency is high ;

(iii) Clinker formation which is mainly a sintering operation, is confined to the top portion of the kiln ;

(iv) The lower portion of the kiln acts as a heat exchanger where the sensible heat of the clinker is recovered by the air ;

(v) Air for combustion is supplied through rotary grate at the bottom of the kiln by a blower ;

(vi) The clinker discharge is controlled by the rotary grate ;

(vii) The clinker obtained are porous and involve less energy in grinding.

The capital investment for a 600-tonne per annum plant would be only Rs. 2 lakhs. The investment per annual tonne is less than half that for a conventional rotary kiln. The strategy, therefore, could be :

(i) Encourage installation of cement kilns of 1 to 3-tonne per day capacity and mobilise local skills of artisans and craftsmen. The kilns could be batch kilns with induced draft, but having nodulized feed.

(ii) Encourage the installation of 100 and 200-tonne capacity mini cement plant, based on modern Vertical Shaft Kilns.

(iii) Revive and modernise construction, without Portland cement.

(2) *Production of Building Bricks :* The conventional brick making industry utilises special type of soil which can be obtained only by removing top soil from agricultural fields. The brick formed will have to be fired in a kiln, utilising coal or oil. All this increases the cost of production. For instance, a *2-crore-a-year* plant for manufacture of bricks in a modern factory would involve investment of Rs. 50 lakhs or so, out of which the cosf of land alone would be Rs. 10 lakhs.

An alternative appropriate technology could utilise the residue left by burning paddy husk as the starting material. The paddy husk ash is admixed with lime and converted into bricks. After 24 hours curing, the bricks are ready for use. They do not need any fuel or kiln for their manufacture. These bricks can be manufactured in a decentralised manner at the village level.

(3) *Production of Industrial Oxygen :* At the present time, industrial oxygen is produced by liquefaction of air using high pressure compressors which are still imported. Also, they make heavy demands on power. An alternative appropriate technology could utilise molecular sieves for production of oxygen on a small scale. Alternatively, the old process of production of oxygen from barium peroxide can be revived. In this process, barium oxide is heated to a particular temperature to convert it to barium peroxide and then maintained at another temperature to facilitate the breakdown of the latter into oxygen and oxide. The oxide could be recycled. This process was abandoned in favour of liquefaction of air, but under Indian conditions like shortage of high power and shortage of pressure cylinders and equipment, one could resort to this method of production of oxygen.

(4) *Production of Calcium Carbide :* Most of the modern methods of production resort to using electric furnaces involving heavy expenditure on power. The alternative method could be to admix charcoal with limestone, nodulise the mix and feed the same into a modified blast furnace utilising enriched air. Calcium carbide could be obtained in molten form. Such plants could be constructed even on a small scale of half a tonne per day capacity with low investments.

(5) *Dry Battery Cell Production :* The Central Electro-Chemical Research Institute, Karaikudi is offering the know-how for manufacture of 1.8 million cells per annum by employing about 40 workers. 33 such production units employ a total 1,650 workers to produce nearly 60 million cells per annum. A corresponding size unit in the organised sector would employ only 1/5th the number of labour.

(6) *Newcomen-Watt Pumps :* Rural electrification has received the attention of Government. The distribution cost, however, becomes costly and uneconomical in relation to power offtake. China is reported to have developed a multi-purpose small horse-power portable diesel pump which the farmer carries to the field and uses not only for pumping water but also for operating other agricultural implements.

It may be worthwhile to revive the early Newcomen-Watt steam engine and use it for pumping water. The advantage would be that these pumps could be made to operate by burning the readily available agricultural waste.

(7) *Micro-scale Industries :* One of the alternatives for accelerating the pace of industrialisation could be to think of micro-scale industries employing not more than Rs. 20,000. Such industries should be simple and should be able to ensure a high return so that the accrued capital could be reploughed to multiply their number. The product to be made or raw materials to be used will naturally have to be thought of as complementary to the existing, small, medium, or large-scale industries. One example of such an industry is manufacture of water filter candle. One of the biggest problems in rural India is the supply of portable water. Candle filter could be manufactured from the indigenously available clay, utilising the local potter's skill. Burnt clay admixed with clay, saw dust and silver nitrate could be utilised as raw material. Presence of silver in traces in the candle ensures bacteria free water. Manufacture of 100 filters per day will not involve an expenditure of more than Rs. 10,000. The cost of each filter would not be more than Rs. 4.

Another example of micro-scale industry could be the manufacture of paper twine for the Cable Industry. The machine would not cost more than Rs. 5,000 and the product which is at present imported should sell at Rs. 30 per kilogram. Several products for use in the Chemical Industry could also be manufactured on micro-scale. Some of them are Silica Gel and Palladium Catalyst.

The above examples only illustrate the possibilities that appropriate technology offers for innovation. Several more can be thought of. What is needed is the mobilisation of the talents in our research and technological institutions and utilise them to develop several appropriate technologies. These technologies cannot be developed in isolation. They would also have to utilise the local artisans and craftsmen, for it should not be forgotten that the first Industrial Revolution was ushered in not by the scientists and technologists but by artisans and craftsmen. It is only through following a 'walking on two legs approach' that we can transform India.

Fiscal Policy and Appropriate Technology

Anand P. Gupta*

Research work on issues concerning the relationship between fiscal policy and appropriate technology has not received the kind of attention it deserves. The importance of such work can hardly be overstressed at a time when the employment problem has turned ugly in many countries and when every effort is being made to find ways of dealing with this problem in an effective manner. This article[1] looks at the employment implications of some of the fiscal measures and makes an attempt to explore ways in which the instrument of fiscal policy can make a significant and lasting contribution to the promotion of appropriate technology in India.

Concept of Appropriate Technology

Let us begin by asking the question, "what is appropriate technology?" While we recognise that this is not a simple question, we believe that an attempt can be made to define appropriate technology in terms of the resource endowments of a country. That is, an appropriate technology is a technology which requires that factor ratio which coincides as much as possible with the factor ratio that the country is endowed with. Thus, in the context of a country like ours which suffers from inadequacy of foreign exchange and where the employment problem has assumed rather staggeringly large proportions, appropriate technology may be defined as that technology which is based on locally-available material resources and which favours the employment of unskilled workers in large numbers. If one goes by this definition of appropriate technology, he can find many examples of the use of inappropriate technology in India.

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1. The article draws on the paper "Public Finance and Employment : The Indian Case", prepared by the author for presentation at the XXXI Congress of the International Institute of Public Finance, Nice, September 8-12, 1975.

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above, and cover a period of twelve years, 1961-62 to 1972-73. Data for the years 1961-62 to 1965-66 relate to 1,333 companies, those for the years 1966-67 to 1970-71 to 1,501 companies and those for 1971-72 and 1972-73 to 1,650 companies. These companies have covered, in terms of paid-up capital, about 80 per cent of all the non-government, non-financial public limited companies in India.

Tax incidence has been defined as the percentage of tax provision to profits before tax. For the years 1961-62 to 1970-71, the percentage relates to all the companies covered in the Reserve Bank of India's studies referred to above,[5] but for the years 1971-72 and 1972-73 the percentage relates to profit-making compantes only. As regards labour intensity, it has been defined as the percentage of wage cost to value of production.[6] It may be noted that the Reserve Bank of India data on wage cost relate to both salary earners and wage earners and no break-up of the data is available to show the relative changes in the shares received by these two groups of income earners.[7]

A striking feature of the trends in tax incidence and labour intensity is that while the average labour intensity of the private corporate sector in India has declined, industries with lower-than-average labour intensity have enjoyed considerably larger relief in tax incidence than industries with higher-than-average labour intensity : Total reduction in tax incidence of industries with lower-than-average

5. Measurement of tax incidence in terms of percentage of tax provision to profits before tax of *all* companies suffers from certain limitations. For a discussion of these limitations, see author's "Burden of Taxation on Corporate Sector." *The Financial Express* (Bombay), July 21, 1973.

6. This may not sound like an ideal way of defining labour intensity in a country like India in which the objective of employment policy is simply that of increasing the numbers employed. But limitations of data availability did not permit us to use a more satisfactory definition.

7. Evidence [illegible] from other sources [illegible]

What is wrose, one can find evidence to show that even public policy has played an important role in the growth of inappropriate technologies: It has not only tolerated such technologies, but has even deliberately favoured their adoption through various means.[2] Tax policy is a case in point. The tax system in India has provided and continues to provide a number of incentives to stimulate industrial development in the country.[3] The use of tax incentives for the purpose of encouraging industrial development rests essentially on the premise that the conterral of tax benefits will induce domestic or foreign industrialists either to initiate activities which they would not otherwise undertake or to expand their activities in already existing enterprises. While development of certain industries is a desirable objective, what is questionable is the design of the tax incentives used to achieve this objective. A careful review of the relevant literature shows that these incentives have been designed in such a manner that generally they not only lack selectivity but the tax benefit associated with them varies in proportion to the amount of investment in a capital asset. When calculating this benefit, no consideration is given to the number of workers employed, or to the quantum of locally or indigenously available inputs or raw materials used in the production of the capital asset. These incentives have operated (and continue to operate) in an environment in which interest rates at which finance has been made available to industry have been maintained at artificially low levels and in which interest has been allowed as an item of expense for tax purposes.[4] The implications of such a combination of policy factors for technology adoption are obvious: By reducing considerably the tax liability and thereby improving the net (after-tax) profitability, or by reducing the

Tax Incidence and Labour Intensity
1961-62 to 1972-73

(*Percent*)

Industry		*1961 —62*	*1962 —63*	*1963 —64*	*1964 —65*	*1965 —66*	*1966 —67*	*1967 —68*	*1968 —69*	*1969 —70*	*1970 —71*	*1971 —72*	*1972 —73*
Coal mining	TI			39.0									
	LI			54.6									
Cotton textiles	TI												28.7
	LI												20.5
Jute textiles	TI											29.5	24.0
	TI											22.4	25.4
Woollen textiles	TI								37.2		31.3		
	LI								23.1		15.0		
Iron and steel	TI	2.46	20.8	30.2				29.5	31.6				—
	LI	19.9	19.5	19.3				23.9	23.1				26.4
Aluminium	TI						16.9	29.0	23.6	4.6	0.1	13.7	
	LI						11.3	12.0	12.2	10.9	10.5	10.9	
Other non-ferrous metals	TI								23.9	24.0	22.7		
	LI								12.1	8.9	8.4		
Motor Vehicles	TI						30.0	30.0	38.3				
	LI						12.3	13.5	13.9				
Foundries and Engg. workshops	TI						29.2			25.7	18.5		
	LI						17.9			19.9	17.9		
Basic industrial chemicals	TI		41.3									29.6	26.8
	LI		11.4									9.1	9.5
Cement	TI					37.7			29.7	23.3	20.4		33.2
	LI					14.6			13.6	12.3	11.7		12.7
Paper and paper products	TI			34.3	40.5	19.5	30.2	38.1	22.5	15.6	30.2	23.3	24.0
	LI			14.7	15.4	15.7	15.5	16.0	15.6	14.8	15.1	14.5	15.8
Elec. generation and supply	TI	25.0	33.1	37.3	40.4	21.3	30.5	21.5	22.3	22.8	33.1		
	LI	10.2	9.1	7.9	8.3	8.9	9.4	9.8	9.5	8.8	8.9		
Shipping	TI			29.1	11.8	2.8	9.3	5.6	15.4	4.4	10.0	7.2	11.0
	LI			15.1	16.3	16.4	15.8	14.6	14.2	13.7	13.0	13.0	13.8
All industries	TI	43.7	52.3	51.0	50.5	51.0	47.8	49.4	49.5	43.7	45.9	41.5	43.3
	LI	16.9	16.9	16.7	17.0	17.1	15.9	16.4	16.4	15.9	15.6	15,1	15.6

TI = Tax Incidence LI = Labour Intensity

Note : The data presented in this table are confined to those cases in respect of which tax incidence works out to at least ten percentage points lower than average tax incidence in a year.

Source : Data from "Finances of Indian Joint Stock Companies, 1965-66", *Reserve*

labour intensity works out to roughly 3.89 times the reduction in tax incidence relevant to industries with higher-than-average labour intensity.[8] Clearly, the way corporation tax policy has operated in India, it has tended to induce distortions which have favoured the employment of capital, with the result that the labour intensity of industrial output has suffered a decline.[9] This can hardly be regarded as consistent with the objective of promoting appropriate technology in a country like ours. We feel a situation of this kind should not be allowed to continue and, therefore, suggest (a) complete withdrawal of all fiscal incentives related to the employment of capital, and (b) complete disallowance of interest as expenditure for tax purposes. These measures, by raising the effective price of capital, should have the effect of influencing the factor-mix in favour of labour.

The above measures should be combined with a deliberate fiscal effort aimed at re-ordering of investment and production priorities with a view to increase the output of goods of mass consumption. A policy measure which deserves consideration for achieving this result is a substantial reduction in the incidence of corporation tax on industries producing specified mass consumption goods. If these goods are in adequate supply, prices can be expected to remain reasonably stable and, as a consequence, beneficial effects may be expected not only on employment but even on income distribution.

An attempt should also be made to explore the possibility of reducing the incidence of excise duties and other indirect taxes on goods of mass consumption. Whatever data are available suggest that the incidence of taxation on at least some of these goods has registered an almost persistent increase. This has tended to cause upward pressures on the cost of living for the working population, which in turn have exerted a perceptible influence on money wage levels. The net result has been a distortion between the relative factor prices—a distortion which has favoured capital-intensive rather than labour-intensive production.[10] In view of these considerations, any reduction

8. As between companies in an industry, this means considerably larger tax benefit to the companies with a relatively high proportion of capital in their factor-mix.

9. This is consistent with a recent Government of India estimate according to which the share of workers' wages in the value added by manufacture fell from 38.5. to 33.7 per cent in the decade 1960-1970.

10. It must be noted that fiscal factors represent only one set of factors which have induced

the rich.[16] But we must hasten to state that these adverse effects are almost certain to be more than offset by the positive gains which are likely to accrue as a result of any significant reduction in inequality. These gains can be expected to accrue because of (a) decline in imports, (b) increase in exports as a result of decline in domestic consumption of certain products which have good demand in world markets, and (c) changes in the pattern of growth rates of output, with output of labour-intensive products growing at a faster rate. To these should be added the gains resulting from reduction in foreign exchange leakages. These leakages, involving considerable amount of foreign exchange, have taken various forms, such as smuggling,[17] expenditure by Indian tourists abroad and outflow of foreign exchange in the forms of royalties, technical fees, head office expenses, project remittances, etc.

No empirical estimates are available of the magnitude of the hypothesised effects which reduction in inequality would have on employment (and other aggregates) in India, but in view of the considerations noted above it appears to us that a potential does exist for improving labour intensity through income redistribution as well. Fiscal policy can be of help in realising this potential, but our country's experience so far with the use of this policy for re-distributing incomes does not justify any ground for optimism. A recent study of the incidence of taxes collected by the central government shows that while the rich pay a considerably higher proportion of these taxes than what the poor pay, the composition of tax incidence on the rich is such that their pattern of consumption remains largely unaffected.[18] To put it differently, as the incomes of the rich have recorded considerable gains and as the

16. Not all the goods consumed by the rich are capital-intensive. Indeed, it has been argued that as the relatively well-to-do consmue labour-intensive personal services and elaborate handicraft products, increasing the degree of inequality may have a more favourable impact upon employment levels. For analyses along these lines, see D. G. M. Dosser, "Tax Incidence and Growth", *Economic Journal,* September 1961; and Paul Strassmann, "Economic Growth and Income Distribution", *The Quarterly Journal of Economics*, 1956.

17. The large scale smuggling of luxury goods which takes place in India (according to an estimate, goods worth at least Rupees 400 crores were smuggled into the country between September 1973 and January 1974) merely reflects the gross inequalities in the distribution of disposable incomes in the country. With a dent on these inequalities, a noticeable decline in smuggling should follow, thus making additional foreign exchange resources available for priority development activities.

18. Anand P Gupta, "The Rich, the Poor and the Taxes They Pay in India : A Study of Central Government Taxes and Their Impact on Income Distribution", World Employment Programme Research, Income Distribution and Employment Programme, Working Paper Number 12 (Geneva : International Labour Office, January 1975).

system of direct taxes has failed to mobilise an increasing proportion of these incomes, the resulting increases in disposable incomes have been so large that increases in commodity prices resulting from indirect taxes have by and large failed to cause noticeable shifts in the consumption patterns of the rich people.[19]

This means that if fiscal policy has to play an effective role in realising the potential which in our opinion exists for improving labour intensity through income re-distribution, certain changes of a far-reaching nature will be absolutely necessary. Part of the thrust of these changes will have to be on shifting the structure of taxation in favour of direct taxes. Such a shift would not only be of help in reducing inequalities in the distribution of disposable incomes, but can also be expected to improve the effectiveness of indirect taxes in influencing desirable changes in consumption patterns.

A careful survey of the present situation suggests that a good part of the success in this area will depend upon what those who are responsible for the administration of the tax system do to curb the rapidly growing menace of tax evasion. A measure of the extent of tax evasion is provided by the near constancy of the ratio of individual incomes assessed for tax purposes to national income. In a country like ours in which national income at current prices has risen rather rapidly in recent years and in which inequalities in the distribution of incomes have tended to widen,[20] one would have expected this ratio to rise, but at least partly[21] because of the widespread practices of non-reporting and under-reporting of taxable incomes the ratio has remained practically unchanged: It stood at 6.74 in 1970-71 as against 6.66 in 1960-61.

It may be noted that while improvements in tax administration are absolutely essential for bringing about any meaningful shifts in the

19. In a number of cases substantial increases in indirect taxes have only promoted smuggling—a situation which, as noted earlier, merely reflects gross inequalities in the distribution of disposable incomes.

20. For a recent survey of trends in income distribution in India, see Pranab K. Bardhan., "The Pattern of Income Distribution in India : A Review", *Sankhya : The Indian Journal of Statistics*, Series C, Volume 36, Parts 2 and 4, June and December 1974 pp. 103-38.

21. Partly, because changes in the ratio of income assessed for tax purposes to national income may also be caused by (a) changes in the effective exemption limit for income tax purposes, (b) changes in provisions relating to the grant of various exemptions, reliefs, deductions and rebates, and (c) changes in the quality of tax administration.

to a considerable degree upon the extent to which such measures are complemented by other policy actions of the development authorities. This is true because the latter, in operating the devices influencing the relative prices of capital and labour, can determine how much of the potential improvement in labour intensity will actually be realised. For practical purposes, it is indeed significant that perverse behaviour of certain key variables can choke off the positive effect of the above measures on labour intensity, thus negating the best of one set of policy intentions.

Second, a bold effort will also have to be made to create conditions which are most favourable for the consumption of labour-intensive output and which are inimical to the consumption of capital-intensive products. Fiscal policy can be of significant help in creating these conditions by directing the prevailing income distribution towards the consumption of relatively more labour-intensive products, as also by reducing inequalities in such a manner that the resulting pattern of income distribution is conducive to the consumption of a more labour-intensive output-mix.

The recent developments give an indication of the ruling Congress Party's determination to make a real move from a socialist platform to a socialist reality. We welcome these developments, but feel that a lot more will have to be done. Let us hope that those in power will rise fully to the occasion and take measures which not only remove the biases towards capital-intensive technologies but also influence the factor-mix and the output-mix in such a manner that the end result of a truly labour-intensive economy is achieved.

Transfer of Sponge Iron Production Technology from Laboratory to Industry

V. A. Altekar **V. S. Sampath**

Sponge iron is a product of solid state reduction of iron ore lumps, pellets or fines. Sponge iron so produced contains most of the original iron oxide in the form of metallic iron. It also contains the impurities like silica, alumina, etc. which are originally present in the ore, in the same form, as they are not reduced under the conditions obtaining in the production of the sponge metal.

The sponge iron is a highly metallised product which may contain metallised iron to the extent of 85% to 95%. It is, therefore, obvious that the purer the original ore, the higher the grade of the resulting sponge iron.

Sponge iron has several advantages as a melting stock over steel scrap, viz.,

(i) it is an excellent melting stock for mini-steel plants;

(ii) it provides a graded and uniform feed stock;

(iii) the physical size enables its application for continuous feeding to the electric arc furnace for steel making;

(iv) it offers higher productivity;

(v) it lowers power consumption;

(vi) it can form a convenient addition to the L.D. converter as a coolant.

The technology of direct reduction has the following major advantages :

(i) Direct reduction for sponge iron production can be a source of primary steel making facility when integrated with electric arc

melting furnace and continuous casting. The concept of mini steel plant can be achieved by such an integrated unit.

(ii) The direct reduction units with capacities ranging from 30,000 ton per annum to 300,000 ton per annum can be economically established, involving relatively very low capital investment unlike the conventional blast furnace, coke ovens, B.O.F. complex which have to be several times larger in size to be economical. The investment requirement for sponge iron plant is about Rs. 1,000 per annual ton for installed capacity only.

(iii) Direct reduction units can be based on non-coking coals and established at various regions where good grade iron ores are located, whereas blast furnace technology depends on selective raw materials and metallurgical grade coal.

Relevance of the Direct Reduction Technology Under Indian Conditions

The technology has great significance to the conditions obtaining in the country. India has large resources of iron ores of good grade and non-coking coals spread widely throughout the country, while coking coal deposits are limited and occur within a rather narrow geographical region. The following factors contribute to the concept of mini steel plants based on sponge iron :

(i) High capital cost involved in the establishment of steel plants based on blast furance technology.

(ii) Non-availability of suitable grade of coking coals.

(iii) Substitution of scrap which is becoming scarce and thereby retarding the rapid development of mini steel plants based on scrap steel.

(iv) Regional development of the steel making capacity in wider areas of the country to remove the imbalance in the industrial development of those regions.

Apart from these, sponge iron has several advantages over scrap steel as melting stock.

Sponge Iron Production Technology

There are several direct reduction processes, but till recently, only three of the processes were commercially operated with good success. A number of plants have been established based on these technologies. Basically, they can be classified into two broad groups, viz., those based on solid reductants and those based on gaseous reductants.

It has been observed that the direct reduction technology based on gaseous reduction have attained a better measure of success due to their continued trouble-free operation over fairly protracted periods. As for those based on solid reductants, the problems relating to design and engineering had been the major problem holding back the progress of those processes. Every day the gap is getting narrowed down with new innovations.

India has to depend more on the technologies based on solid reductants as we have an abundance of non-coking coal and lignite. We have rather limited resources of natural gas and, although, of late some promising areas have been located, they need to be fully assessed and developed for exploitation.

The National Metallurgical Laboratory, keeping in view all these aspects, launched a multi-directional approach to evolve a suitable technology for adoption in the country, based on the indigenous sources of raw materials. The various investigations under active progress can be briefly classified as :

(i) Rotary kiln reduction based on coal,
(ii) Vertical shaft furnace based on coal,
(iii) Vertical shaft furnace based on naphtha,
(iv) Vertical shaft furnace based on coal gasification.

Among the various approaches, considerable progress has been made on the process based on rotary kiln reduction, and this technology is now under transfer to the industry.

In 1970, an existing rotary kiln of size 10 metres long and 0.9 metre inside diameter which was primarily used for drying, calcining,

and pre-hardening of pellets etc. was modified to suit the production of sponge iron. Initial trials were very encouraging and high degree of metallisation, over 90% was achieved. While testing a new sample of ore and coal from a different source, the results were rather disappointing in that it gave a metallisation of only 70% and also affected the smooth operation of the kiln, resulting in the abrupt closure of the campaign.

It then became necessary to study the characteristics of the raw meterials and suitably match them for optimum reduction in the kiln. A number of iron ore samples from various sources were studied and successful campaigns were run with iron ore and coal deposits from Donimalai, Kiriburu, Bailadila, Surajgarh, Barpada, Ghugus, Singareni, Bellarpur, Talchar, Rampur, Samla etc., where production rates of 3-4 tonnes of sponge iron per day were achieved. It has been established by several campaigns that metallisation may vary from ore to ore and range between 85%-95%.

To optimise conditions for trials on larger scale, continuous improvements and modifications of the original kiln were effected and this in itself has generated a good knowledge about design aspects to enable the laboratory to undertake design of mini sponge iron plants of capacities ranging from 30,000 to 50,000 tonnes per year.

Several hundreds of tonnes of sponge iron were produced from the experimental kiln. The sponge iron so produced has been successfully employed for steel making in industrial electric arc furnaces.

Transfer of Technology to Industry

To convince itself and gain complete confidence of the technology developed, the laboratory carried out several campaigns by arranging to obtain raw material samples of varied characteristics from different regions. This approach had to be initiated to take care of the possible problems that may arise out of the vagaries in the nature of the raw material resources.

The laboratory carried out persistent and patient work involving several extensive trials and produced sponge iron on tonnage lots. Several state

sector projects on the pilot-plant trials for sponge iron production based on their local raw materials were undertaken such as from APIDC, IDCOL, etc. Sponge iron melting trials were initially conducted in a 0.8 tonne capacity electric arc furnace unit in the laboratory. Based on the success of these trials the laboratory initiated correspondence with the HSL-Bhilai and the HEC-Ranchi.

Tonnage lots of sponge iron produced at the NML were transported to these plants to carry out inplant trials in their large sized electric arc furnaces. These trials were very successful and created considerable confidence in translating it for commercial purposes.

The laboratory has also prepared a technical fesasibility report for the establishment of sponge iron production units in the country with capacity of 30,000 tonnes per year.

A proposal was also made to the ministry of Steel and Mines for funding a project. Similar proposals were also made to NCST. The laboratory had been very persistently trying to identify a customer who could finance this project to enable the process to take deep roots in the country and assist the existing and projected mini-steel plants.

Unfortunately, there has been considerable delay in obtaining a favourable response from either the steel ministry or the NCST.

In the meantime, the laboratory started tapping other alternatives. The potentiality of the technology and the socio-economic importance of the project were highlighted on various platforms so that the technology is not allowed to rest on the way-side, loosing its vitality.

The laboratory did not have the necessary finances to go ahead in a big way on its own and had to seek the help of an entrepreneur. In the end, an entrepreneur, M/s. Andhra Cement Co., Vijayawada, Andhra Pradesh, was identified who commanded certain infrastructure facilities. The company had an old cement kiln 45 metres long, which was placed at the disposal of the NML in January, 1974. The kiln was examined and it was found that it needed many modifications.

A team of scientists, embodying various disciplines of the laboratory visited the plant and necessary design modifications were drawn out and

sent to the firm. The kiln was modified in a record time and no load tests were carried out in January, 1975 under the supervision of the NML scientists. Further, modifications were again suggested in the light of the performance of the blank run of the kiln. After the completion of the final modifications, the rotary kiln was got ready for regular test trials in March, 1975.

In the mean time, the raw materials to be tested were evaluated in the laboratory in all respects to optimise the operational parameters for rotary kiln trials.

The unit was commissioned fully and regular campaigns were initiated. The results have been very encouraging and metallisation between 85-90% has been achieved. Under highly optimum conditions metallisation over 90% has also been achieved.

The experience gained by the NML scientists in the design and commissioning of this prototype-cum-demonstration unit will greatly help in establishing similar units or even larger units in various regions of the country.

The entire plant can now be fabricated within the country, involving no foreign exchange. A plant with a capacity of 100 tonnes-per-day is likely to cost around Rs. 300 lakhs. It is estimated that in a 100-tonnes-per-day capacity plant which is logistically located, the cost of production per tonne of sponge iron would be in the range of Rs. 350 to Rs. 400. The whole technology developed right from its bench scale to its present status of a prototype unit has given the concerned scientists the unique experience of how to make a dent in the industry from the stage of an embryo of project which has great potentialities.

It has also very well exemplified the fact that success is sure to come to those who are tenacious and have great perseverance. It has also demonstrated the fact that in India entreprenuership exists that is willing to put faith in indigenous technology and to take risk if required.

Building with Plastics : Prospects for Regional Collaboration

O. P. Ratra

Housing experts the world over are engaged in offering solutions to ease growing housing demand. These include, low-cost housing through pre-fabrication and industrialised building techniques, use of new and traditional building materials, as also their potential availability through conversion of industrial and agricultural wastes, and the plastics-based materials of more recent origin.

Building materials, as is well known, constitute an important factor influencing the total building costs, which in turn are rising rapidly, as against the consumer price indices. Wages tend to rise more rapidly than the cost of building materials. In other words, housing is becoming more costly in relation to other goods and services.

In the wake of expanding house building activities in developing countries, the increased production and availability of building materials have attained greater importance at national levels. It is an established fact that the traditional building materials fall short of their supplies, and at times, performance too, in view of the technological developments in the building industry.

Search for New Building Materials

In the search for new and economical building materials, major research and developmental efforts have been directed to plastics, in industrially advanced countries. The growth of world plastics industry has been enormous, from little over 3 million tonnes in 1955 to 43 million tonnes in 1973; by 1980 it is expected to touch 96-million tonne mark. And by 2000, it is estimated that synthetic products (thermo-plastics, lacquer raw materials, adhesives, synthetic fibres etc.) will account for about 78% of world consumption of structural materials, while, metals will represent only 19%. Today, plastics are next only to metals in the *per-capita* consumption of materials in the world.

To date, more than 200 plastics building systems—prototypes of all-plastics houses—have been designed and erected in major plastics producing countries. An International show for plastics houses was held at Lueddenshied, Federal Republic of Germany, in 1971. With a few exceptions, not many of these systems had actually been built and used as houses, as these were not found to be economical. However, these systems served as useful developmental efforts, and provided ready solutions for structures required for holiday homes, camping shelters, exhibition halls, sports arenas, as also for emergency housing. A variety of designs and architectural features have been evolved, and many of these have made use of glass-fibre re-inforced polyester resin, PVC extruded profiles, sandwich panels, and air-supported structures based on plastic-coated fabrics made of synthetic fibres—such concepts have been developed from the familiar inflatable structures and offer new and interesting solutions for roofing large areas, such as shopping centres and the like.

During the last two decades, the world plastics industry has concentrated its resources in exploiting potentialities of plastics for the building industry. Estimates to the effect that over 25% of the world production of plastics goes into various building applications, that the building materials market for plastics constitute around 5% in value, and building industry is the major consumer of plastics in the world, have not been uncommon in the published literature. If we carefully analyse the consumption figures for plastics in building in developed countries, we arrive at a conclusion that these indicate plastics applications for a range of individual building components/products, and the reason for their increased utilization is cited in favour of preferential adoption or substitution, or more appropriately, to upgrade the utilities and services in the building industry.

Since the latter months of 1973, the scope for expansion and diversification of the plastics industry has been questioned in various national and international forums, in view of the dramatic increases in price of crude oil. It is a known fact that hardly 3% of the crude refined in the world today is used for petro-chemicals.

There has been world-wide inflation. As a result, the pattern of consumption of plastics is one area that has been seriously affected. This obviously calls for re-assessment of the concept of dependence of

plastics industry on petro-chemicals, and the competitive position of plastics in relation to other industrial raw materials. However it has been observed that there has been substantial corresponding increase in the prices of traditional industrial raw materials. In general, it is found that the increases for finished plastics products are in most cases of the same order as those of competitive finished products made from other materials. It must be borne in mind that although plastics compete with traditional materials on price basis, their technical performance also has relevance in their overall acceptability. Because of lower density of plastics in relation to other raw materials, together with the less labour-intensive processing necessary for production of finished components, plastics have remained competitive, despite the fact that overall increase in their raw material cost has been greater than that for other materials.

Why Build with Plastics ?

The bulk of traditional materials are produced with a minimum of conversion efforts. The production of sophisticated materials like plastics, had necessitated the importation of manufacture and applications technology for developing countries. Among the several qualities which have favoured plastics in the manufacture of building components are their adaptability to mass production techniques in a variety of shapes and profiles to very close tolerances, light-weight, high strength-to-weight ratio, corrosion resistance, built-in-colour, light transmission, and ease of manipulation into components of any specific design. In terms of their applications in the building industry, plastics as new materials have certain limitations also, under actual conditions of use. In the early days of development of these applications, there have been charges and counter-charges by the building industry that plastics industry had been working in isolation of the user requirements, designing components without any consideration of the fact that the material properties of plastics were much different from those of traditional materials. There had been frequent failures of building applications in plastics, and as a result, plastics industry has gradually appreciated the basic requirements of the building industry and have been engaged in experimentation and perfection of a number of useful building applications.

A demand for increased use of plastics in general, and more recently, for a number of building applications has been created in developing countries. India, the Republic of Korea, Iran, Pakistan, the Philippines, Brazil, Chile, and Mexico, are some of the countries where plastics raw materials production has been established. Processing facilities for plastics into a range of end products, exist almost in all the developing countries. The average *per-capita* consumption of these materials in developing regions is between 0.2 to 1 Kg. The *per-capita* consumption in Latin America is around 4.74 Kg. It is estimated that by 1980, the consumption of major thermo-plastics in the developing countries in Africa, Asia, the Far East, Latin America, and the Middle-East would be around 4.90 million tonnes and this would hardly mean 5% share in total world production of plastics.

The following building applications in plastics have appeared in developing countries :

> Electrical fittings and fixtures, paints and varnishes and related surface coatings, water-proofing and damp-proof coarse materials, sanitary fittings and fixtures, bath-tubs and rooflight sheets in GRP, flushing cisterns in high impact polystyrene, thermal and sound insulation materials, water-stops and corrugated roofing-sheets in PVC; pipes and fittings for cold water services, soil-waste and underground systems, decorative laminates; wall-cladding and panelling in PVC and polystyrene; floor and wall coverings in PVC, nylon carpets, and adhesives for wood-based panel industry.

Noticeable changes, recently, have been the availability of high density polyethylene woven fabric, and PVC coated nylon fabric, which could be suitably used for designing emergency shelters, air-supported structures for exhibition halls.

Limitations of Plastics Building Products

The consumer acceptance of any new product is an important aspect of study. It is more so in the case of plastics building products being advocated for the developing countries. Developing countries require to encourage only need-based building applications in plastics, keeping in view the user requirements of the local building industry. The outright

acceptance of the use of plastics in the building industry based on the experience of industrially advanced countries has at times posed several inhibitions in promoting the use of plastics in the building industry in developing countries. Factors such as overlooking the socio-economic and climatic conditions and the absence of standard/performance specifications for plastics under conditions of use have also hindered the growth of the building applications in plastics.

The use of plastics building products exposed to extreme weather conditions, cold or hot and humid, has certain limitations, and if these are not taken care of while selecting the suitable plastics material for the required building application, including the choice of additives and colours, the product may lead to ultimate failure in performance. Efforts are being made by the plastics manufacturers and the research institutes in advanced countries to standardise formulations of plastics materials for products to be used under different conditions, but the problem still persists. The situation calls for a systematic study of these in developing countries based on local requirements and experience.

There is no denying the fact that plastics are basically 'delicate' materials to handle, vis-a-vis the traditional building materials, in building applications. Plastics do perform better in certain respects as against the conventional materials; however, their handling and installation on constructions site, require education and training of the users, and the tradesman in the building industry. After proper installation, the user, as a resident of the house is faced with equally critical situation of being guided with the term 'plastics' *versus* metal or wood, and their respective performance under conditions of use. This necessitates re-orientation of the user habits for owners of the houses incorporating plastics products in their design. The users in developed countries were faced with similar situations in the early stages of development of building applications in plastics. Over the years, learning from their initial failures, and improving upon the products, their experience has shown, that plastics are useful in upgrading the utilities and services in the bulding industry. On the other hand, many developing countries are still beginners, both in the manufacture and the use of plastics building products, and their local experience and failures will help them learn better for the requirements of the building industry. This is a gradual process, and the developing countries cannot afford to adopt these new materials and applications technology as fast as expected of them.

Prospects for Regional Collaboration

By 1980, it appears that countries in almost all the developing regions would claim to have their indigenous production of plastics raw materials. Petroleum producing countries in Africa and the Middle-East are already set out for industrialization and diversification, and the petro-chemicals-based plastics industry is one such field, likely to be exploited. Coupled with this, would be the local demand for housing, basic, low-cost, and other institutional and commercial buildings, and the fact that imported building materials/components represent between 60-70% of the total value of imports in the Middle-East and African countries. The need for diversification of the plastics industry to supplement local building materials production would be pertinent. Keeping these facts in view, and user requirements of the local building industry in respect of socio-economic and climatic conditions, it would be opportune to learn from the experience in this field from advanced countries, and it would be more appropriate to learn from the failures and the experiences of developing countries which are gradually approaching the status of 'developed countries'. In other words, the regional collaboration among developing countries for exchange of local knowledge and experience in the manufacture and applications technology of plastics in building would be desirable and useful. Regional collaboration in the field of development and promotion of the use of plastics in the building industry holds out good prospects of being advocated among developing countries. Developing countries which have built up expertise in the manufacture of plastics building products and their applications under local conditions, could exchange experience based on the local requirements and extend the same to less developing countries which are planning to establish plastics industries. This could take the form of exchange of technical know-how, and case-histories of manufacture and use; exports of plastics building products; formation of regional working groups, organisation of regional seminars, training courses, meetings; publication of technical reports on developments of mutual interest; and also undertaking applications development research programme region-wise by promoting only need-based applications in plastics, and studying their performance requirements under local conditions.

Since plastics are relatively new building materials, there are still reservations in developing countries on the part of architects, engineers and builders, in adopting or specifying these, especially in the absence

of sufficient quality control and standardisation both in manufacture and use. Technical bulletins under the titles 'Plastics in Building', 'Building with Plastics' and 'Architectural Plastics' are periodically issued by trade, professional, building research and development organisations. Further, seminars and training courses have helped bridge communications gap. The building research and development organisations in developing countries, in association with the local plastics industry need to encourage and undertake such activities.

Developing countries can ill-afford to invest large sums of money in undertaking research and development activities in the use of plastics in building. Certain aspects of the problem are required to be studeid locally and for this purpose, regional requirements and experience could be pooled at one source and work initiated through the research and development facilities existing in developing countries. The regional collaborative practice already exists for a number of scientific and technical fields, except, perhaps, for the plastics industry. The work towards plastics in building is to be co-ordinated regionally, and if not initiated already, the same is required to be undertaken on the regional experience. Applications development is time-consuming and costly and plastics products must be evaluated on their own merits.

Performance-Oriented Approach

The routine testing and standardisation of new building products including those based on plastics which are inadequately supported by local experience in manufacture and use, have invariably been found to be a failure in performance. The current concept of performance-in-use through research-oriented investigations, technical assessment and evaluation of new building products and techniques, first introduced in France under the name 'Agrement System' (now knows as ' vis technique') and later in the UK and other European countries has proved to be very useful for the building industry for adopting innovations in materials and construction techniques. Such a practice has also helped in making plastics acceptable for a number of building applications. The proposition of introducing 'Agrement systems' in developing regions/ countries appears to be promising since there is an awareness of adopting new building materials and construction techniques in relation to the development and promotion of improved building technology to meet the

growing housing demand. In view of this, the need to establish 'Agrement systems' country-wise or region-wise among developing countries, utilising the locally available testing and evaluation facilities can hardly be over-emphasized. Such a practice would infuse a sense of confidence while adopting building products and construction techniques, from one country to the other, in a region, and facilitate the spread and growth of innovations in the building industry including those based on plastics.

Research and development work are fundamental for successful introduction of new building products and techniques. With the pace of development in plastics materials technology – structural PVC and polystyrene foams, and plastics-composites in advanced countries and their diversification into building applications, the developing countries need to assess and evaluate these from time to time to determine their suitability for adoption in the local building industry.

The frequent *caution* that plastics are prone to fire hazards, and produce thereby toxic fumes and that their outdoor performance under tropical conditions is rarely satisfactory, and always questionable, has prompted the plastics industry to undertake development work in plastics-composites technology. Such developments are required to be undertaken in developing countries, advocating the use of plastics in conjunction with traditional building materials, industrial and agricultural wastes.

Role of Indian Technology

India holds a prominent position among developing countries in the manufacture of plastics raw materials and their applications. All the major thermo-plastics and thermo-setting resins are produced in India. In regard to processing equipment, while most developing nations have generally relied on imports from industrialised countries, Indian plastics industry has already developed an indigenous capability by means of joint ventures or licences from international manufacturers. Besides, a large number of machinery manufacturers have come up in almost every major town in the country, primarily engaged in designing and engineering small capacity machines, hand-operated or semi-automatic. The whole range of injection moulding, blow-moulding, vacuum forming machines, extruders and hydraulic presses are manufactured and cater to the requirements of the plastics industry.

Tool-making facilities have long been recognised as key to the development of the industry. Several large-scale processors have their own tooling operations. An institute for Plastics Engineering & Tools (CIPET) has been established with United Nations' assistance, at Madras since 1968. The Institute is well equipped and offers facilities for training of operators in mould making and mould design, both to the Indian plastics industry, and others from developing countries.

Though the current resin production facilities are in the private sector, the public sector is expected to play an important role in future, when the Indian Petro-chemicals Corporation Ltd (IPCL) complex goes into full operation by 1977. It will make available about 1,40,000 tonnes/year of thermo-plastics-low-density PE, polypropylene, polystyrene, and copolymers, nylon, and acrylics. An Applications Development Research Centre is also planned by IPCL at Baroda.

Commensurate with the planned petrochemicals-based resin production since 1968, the Indian plastics industry is poised for production target of 500,000 tonnes of various plastics raw materials by 1980, and this would amount to one-fourth share of total resin production among developing countries in Asia and the Pacific region.

The industry has developed a remarkable range of products for consumer and industrial applications including packaging, electrical and electronics and building construction. Building applications have been growing rapidly. Production of rigid PVC pipes for electrical conduits and cold water services which exceeded 10,000 tonnes in 1974, is likely to double during 1975. Other building applications like PVC floor and wall coverings, flushing cisterns in high-impact polystyrene, a whole range of sanitary fittings and fixtures in polyethylene, ABS and polypropylene, are presently accepted with confidence by the building industry. List of plastics building products currently produced and marketed in India is given in Annexture 1. Building applications under development include, PVC soil/waste, rainwater and underground drainage piping systems, overhead water storage tanks in polyethylene, and GRP; door and window-frames in PVC-resin wood-flour composites.

The National Buildings Organisation in the Ministry of Works and Housing has been responsible for evaluating and recommending development and promotion of building applications in plastics, and maintains well-

equipped 'Plastics-in-Building' information service for the benefit of engineers, architects, builders and would-be-entrepreneurs. The NBO has been appreciative of judicious use of plastics in building and promotion of need-based applications, keeping in view their performance requirements under local conditions of use. While the question of achieving economy in cost of construction is kept in view, the technical performance of plastics in building applications is not overlooked, as plastics should be studied on their own merits.

The NBO has been seized of the urgency of initiating Applications Development Research Programme on the use of plastics in building, and has recently taken up this work with the active co-operation and participation of resin manufacturers, Indian Petrochemicals Corporation Ltd, Central Institute of Plastics Engineering & Tools, and Building Research and Development institutions. In its efforts to extend its activities in the field through developing countries, NBO in collaboration with UNIDO has been engaged from time to time in propagating the judicious development and promotion of plastics in the building industry. As a result of these efforts, and NBO's active participation in UNIDO's activities, a seminar and training programme on plastics in building—are being planned by UNIDO, scheduled for Jan-March 1976 at New Delhi, for the benefit of developing countries. This will be the first of its kind initiated by UNIDO for developing countries and NBO's involvement and contributions, with the active participation of the Indian plastics industry, would go a long way towards increasing the utilization of plasics in the building industry in developing countries.

In the fields of exports, the performance of the plastics industry has been commendable. During 1974-75, the rigid PVC pipes for electrical conduits and cold water services fetched Rs. 2 crores through exports to Middle-East countries. Besides, a sizeable quanitity of electrical fittings and fixtures are regular/plastics products of exports.

Conclusion

Under bilateral Technical Co-operation Programmes or through the assistance of international agencies like the United Nations Industrial Development Organization (UNIDO), developing countries could benefit from the available experience in the manufacture and applications

development technology in respect of plastics building applications in India.

Though the concept of low-cost housing by building with plastics may not be achieved directly, there are evidences of successful experience in upgrading the utilities and services in the building industry through use and diversification of plastics in building applications. The comparative economy coupled with the technical performance are to be simultaneously advocated, while promoting building with plastics. Keeping in view the availability of raw materials, and the local requirements, socio-economic and climatic conditions, the following need-based building applications are suggested for mass-introduction and diversification through regional collaboration among developing countries:

1. For rural and urban water supplies, soil/waste, rainwater and underground drainage systems. Piping systems in Rigid PVC, high-density polyethylene, as replacements to costly GI/CI pipes.

2. Sanitary fittings and fixtures, like water taps, stop-cocks, showers, basin and sink wastes, gratings, syphons, float valves and balls, in polyethylene, polypropylene, and ABS; as replacements to costly and scarce non-ferrous metal fittings.

3. Flushing cisterns in high-impact polystyrene/polyprophylene; overhead water storage tanks in polyethylene/GRP.

4. Door and window-frames, and shutters in plastics-composites, (like PVC resin-wood-flour or polypropylene-wood-flour composites) structural polystyrene or PVC foam.

5. Cladding panels in thermosetting concrete i.e., industrial wastes like stone dust/gravel/fly-ash in conjunction with polyester resins.

6. Economic roofing sheets using waste polyethylene lined paper bags.

7. Emergency housing using high-density polyethylene woven fabric.

Annexure I

List of Plastics Building Products Currently Produced and Marketed in India

1. Surface coatings, paints and varnishes
2. Resin-bonded wood based panels
3. A range of electrical fittings and fixtures
4. Electrical conduits in PVC and PE
5. Pipes and fittings in rigid PVC and PE, including taps, showers, basin and sink wastes, wastes traps, float valves and balls etc. in polyethylene and polypropylene
6. Decorative laminates for surfacing furniture and panelling
7. PVC asbestos floor tiles
8. PVC coated wall paper, polystyrene wall panels etc.
9. PVC extruded profiles for panelling, partitions, shutters, louvers
10. PVC handrails, curtain rails and staircase nosings
11. Epoxy resin floor toppings for industrial floors
12. Rooflight sheets in GRP
13. Glazing and partition decorative panels in GRP
14. Polyethylene film for water-proofing and damp-proof course
15. Bath tubs in GRP
16. Concrete formers in GRP
17. Overhead water storage tanks in GRP
18. Flushing cisterns in High-impact polystyrene
19. Thermal and sound insulation material-expanded PS
20. Water-stops in PVC
21. False-ceiling panels in GRP, high-impact, and expanded PS
22. Window stays and fasteners in PP
23. WC seats in PF and UF, PS
24. PVC leather cloth (including foam PVC)

REFERENCES

1. Ratra, O. P. 'Building with Plastics—Problems & Prospects in Developing Countries'. Paper presented at the Symposium on Plastics Industries in a Developing World, held at London during June 18—20, 1973.

2. Ratra, O. P. 'Prospects for incresing utilisation of plastics in the building industry in developing countries'. UNIDO Report (1974). United Nations Industrial Development Organisation, Vienna.

3. — — Draft Report of the Expert Group Meeting on the Use of Plastics in the Building Industry. ID/WG-91/16. 1972. United Nations Industrial Development Organisation, Vienna.

4. Ratra, O. P. 'Building with Plastics –Co-ordinated Development and Performance Approach Necessary'. *Chemical Times*, Supplement on Plastics & National Growth, March 20, 1975. Bombay.

5. Ratra, O. P 'Need to identify priority applications of plastics'. *The Economic Times*, 25 May 1975, New Delhi.

6. — — 'Building with Plastics' Supplements, Sept. 1972 onwards, *Popular Plastics*, Bombay.

Development Strategy for Electronics Industry: Ensuring Success of Technology Innovation*

A. Parthasarathi

The Bhabha Committee covered, in its path-breaking Report, a number of aspects of the development of a balanced electronics industry. These ranged from the volume and pattern of expected demand, to the magnitude and time phasing of investment in productive capacity needed to meet such a demand, to the strategy for developing in the shortest possible time a self-reliant base of manufacturing knowhow, to the manner in which production at various tiers of the industry should be organised, and the manpower needs for research, design development and manufacture. However, without doubt, pride of place has been given to the need for freeing the industry from its acute dependence on foreign sources of technology. The means for achieving this goal was repeatedly emphasised in myriad different ways throughout the Report, viz., a major commitment of resources to the generation of manufacturing knowhow through indigenous design and development (D & D), both within and outside production plants. The committee had a very convincing rationale for according such priority to indigenous D & D, as the following extracts taken from different sections of the Report indicate :

"The process of manufacturing equipment under licence has built into it a natural tendency towards obsolescence. Licences are normally sought to be obtained only for equipment which has been well tried out in use, and which has therefore been in production for at least some years. Another two years lapse after the licence has been obtained before indigenous production starts. In the fast-moving field of electronics this automatically means that the equipment which will be produced in the country will be at least five years out of date."

"Moreover, foreign collaborators often change their models, with the result that the components required for production of equipment under licence become difficult to obtain when their production in the country of origin is discontinued. Consequently, the indigenous industry will often be forced to stock large

*Reproduced from *Economic and Political Weekly*, Review of Management, Vol. V. No. 48, Nov. 28, 1970.

quantities of components to maintain the production of equipment under licence and for repairs."

"A serious and undesirable feature of the present situation is that foreign collaborators often dictate the sources of procurement [of components] themselves. This is accepted as the Indian manufacturer does not possess enough design expertise, even after paying for knowhow, to be able to adapt equipment designs to use components available indigenously or in the world market at competitive prices. This largely annuls whatever reductions in cost and in foreign dependence are apparently achieved by going in for foreign collaborations."

Taking its cue from the Bhabha Committee, the Electronics Committee has concentrated its attention, during the three and a half years of its existence, on placing contracts on laboratories, universities and companies for developing, what I shall for the moment call, 'know-how'. As of today the Committee has placed some 18 such contracts. The outlay on these contracts during the first year of actual finding, viz., 1969, has been around Rs. 33 lakhs while that in the coming year is about Rs. 1 crore. However, before the Electronics Committee came on the scene, and indeed even after, government agencies with major interests in electronics such as the Department of Atomic Energy (DAE), the Defence Research and Development Organisation (DRDO) and the Council of Scientific and Industrial Research (CSIR) had undertaken a number of D & D projects with their own funds oriented towards agency specific goals. Unfortunately, no data is available on the total number of D & D projects under way in the country as a whole, the problems they are tackling and the resources that have been utilised by them.[1] It is, however, possible to make a 'guesstimate' that during 1969 the total national outlay on electronics D & D was of the order of about Rs. 6 crores and that the number of scientists and engineers (but not supporting staff) engaged on it, again on an optimistic basis, was of the order of 7,000. These figures may be compared, in order to get some perspective, with the Rs 3 crores and 6,334 scientists and engineers, assessed as being engaged in electronics R & D in 1966.[2]

The question arises : have any of these projects reached the stage where even pilot plant or prototype production, utilising the knowhow generated by them, have been established ? It is a matter of regret that, as far as those supported by the Electronics

Committee are concerned, none except two can make such a claim to what is often used as a criterion of 'successful' D & D. The corresponding figures for projects undertaken as a result of decision taken at the agency level are unfortunately not known. It is, however, possible to secure an overall national estimate from a consideration of the proportion of electronics output,other than of radio receivers which is based on locally developed knowhow. I have computed this to be 40 per cent for the year 1966 (about Rs. 6 crores in absolute value) and 22 per cent for the year 1968.[3]

"Improvement' at such a pace in the aspect of the electronics industry to which the Bhabha Committee attached pride of place can hardly be taken as satisfactory. We are, therefore, forced to examine the fundamental reasons for such a failure.

As might be expected there is much disagreement as to what these reasons are. According to one school, the basic cause of such a low 'success rate' level for indigenous D & D is the abysmally low *absolute* of national expenditure on the activity. This school points out, in support of its contention, that had the growth pattern of D & D resources outlay recommended by the Bhabha Committee been really followed, the country should today be spending about Rs. 17 crores[4] on such activity instead of the Rs. 6 crores mentioned earlier. This school subscribes, if unconsciously, to the Freeman thesis[5] that, D & D, whether at the level of the laboratory, the company or the nation, is a 'threshold level phenomenon, with the result that unless 'an absolute minimum' amount of resources are invested in the effort, no results whatever will result. Of course, they are unable to indicate what this 'minimum' should be or, more importantly, what criteria should be applied to determine its magnitude. Consequently, there is a tendency to argue that whatever the minimum might be, our present outlays are so far below it that, for the time being at least, the 'sky is the limit' for increases in D & D outlays on electronics.

The second school argues that the pace of change in electronics is so great and the technology with which we started our effort at planned development of the industry in 1966 so far behind that in the industrialised countries that we should cease to be concerned about the adequacy or otherwise of our domestic D & D effort. We should instead, it is argued, "follow the Japanese road" and rely overwhelmingly on transfusions of manufacturing technology from abroad. Persons belonging to this

school cite in support of their argument the very fact that so much of our present electronics production is based on technology imported from abroad and so little utilises that generated locally.

Need for Technological Innovation as a Total Process

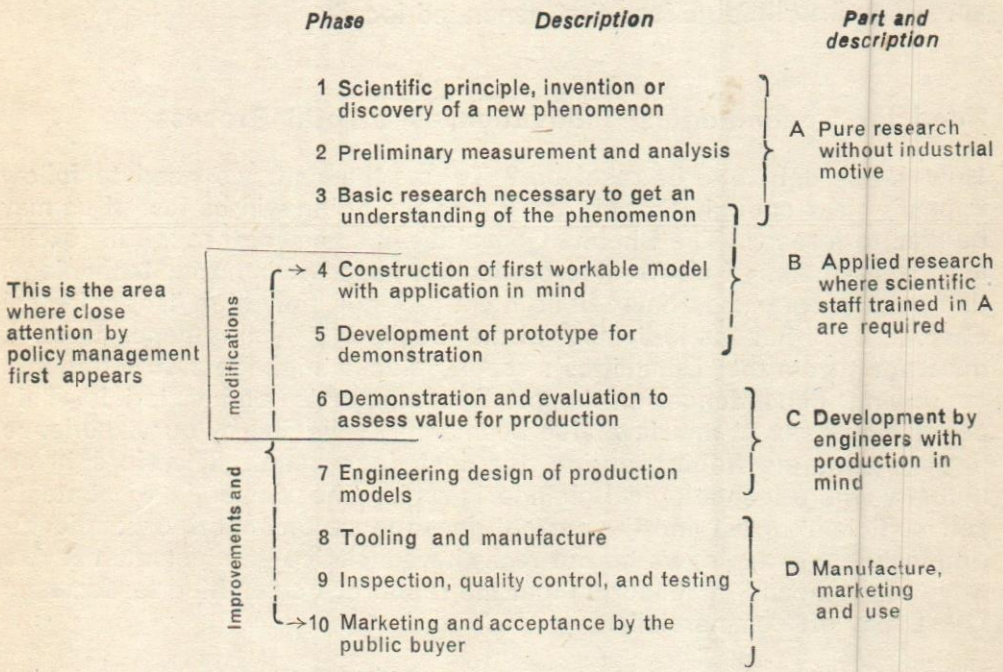
How is this debate to be resolved ? To me the path we need to follow appears clear enough, though how rough the going will be few of us may be able to foresee. The Bhabha Committee has shown, through its excellent case studies of electronics production based on imported technology, that such programmes have built into them not only high technological obsolescence but, as indicated at the beginning of this paper through quotations from the Committee's report, also a high cost structure and continuing dependence on imported components and materials. This conclusion has, in my view, also been amply validated by our experience in developing electronics during the last four years. Therefore, in an industry where technological change is rapid, the demands of strategic self-sufficiency great and the current dependence on imported manufacturing technology acute, we do not really have a choice—we just must devise ways and means of ensuring that the resources committed to domestic D & D pay off commercially.

If we are to have any chance at all to achieve this goal it is imperative that we accept the need for a fundamental change in the conceptual framework, the institutional forms and the executive procedures within which we have been attempting to pursue R & D in electronics. Such a change must arise primarily from the recognition that, in fact, the arguments of both these schools really miss the central issue, *viz*, that neither the mere performance of what we have been terming D & D nor the mere setting up of manufacturing activity using imported technology is a sufficient condition for sucess. The focus has to shift to conceptualising, institutionalising and implementing technological innovation in electronics as a total process.

The Innovation Chain

Technological innovation may be defined as the process by which knowledge on how to produce a product not available in a given

Chart 1 : **Technical Progress Chart Research Through Development to Use**



market, or how to improve the performance of an existing product, reduce its production cost or market and distribute it more efficiently, is made a reality. It is only during the last five years or so that even the industrialised countries have come to understand in operational terms, how technological innovation occurs. The process can be visualised conceptually in terms of a simple model of a chain made up of a number of links. This is shown in Chart 1. It will be seen that there are some 10 links in the chain, each of which constitutes a specific type of activity. Such a model brings home to us immediately that what the Bhabha Committee has called D & D is not a self-contained and self-sufficient activity but only one part of the innovation process. It therefore follows that even 'successful' D & D—and I shall come later to how 'success' in D & D might be assessed—will be of absolutely no value in an economic sense, unless it is both preceded and followed up by a number of other steps, closely interrelated with it.

Let us now examine the model shown in Chart 1 a little more carefully. I would, however, like to preface such an examination with a word of caution, *viz*, that the model has been borrowed from an industrialised country and so it may not be completely appropriate to the conditions prevailing here. It will be seen that the model has been so structured as to enable each activity in the chain to be associated with the kinds of manpower needed to undertake it, the goal such manpower is working towards and the institutional setting in which the work is to be carried out. Part A covers basic research, undertaken usually in academic institutions and, to some extent, in government laboratories, by scientific staff who are leaders in some specialised field, and aimed not at making any particular invention but at the advancement of basic scientific knowledge. Part B spans the gap between basic research and engineering design, which we often call Development. The kind of personnel required here are largely those with scientific backgrounds acquired from participating in Part A activity, but also include some engineers. The activity undertaken is often as complex as that tackled in Part A, but is more directed at producing a new product or process in the short term. Part C is a stage manned almost completely by engineers whose sole aim is to get products and processes 'ready' for production. The final part D deals with the (supposedly) well understood activity of industrial production, marketing, sales and after-sales service.

Implications for Policy Making

We can now draw several important deductions from the innovation chain delineated above, which are relevant to policy making. These are:

(1) Innovation is inextricably concerned with interfaces—technical, economic, institutional and behavioural—and it is on the identification of such interfaces and on ensuring smooth and effective flow of information and action across each of them, that successful innovation largely depends.

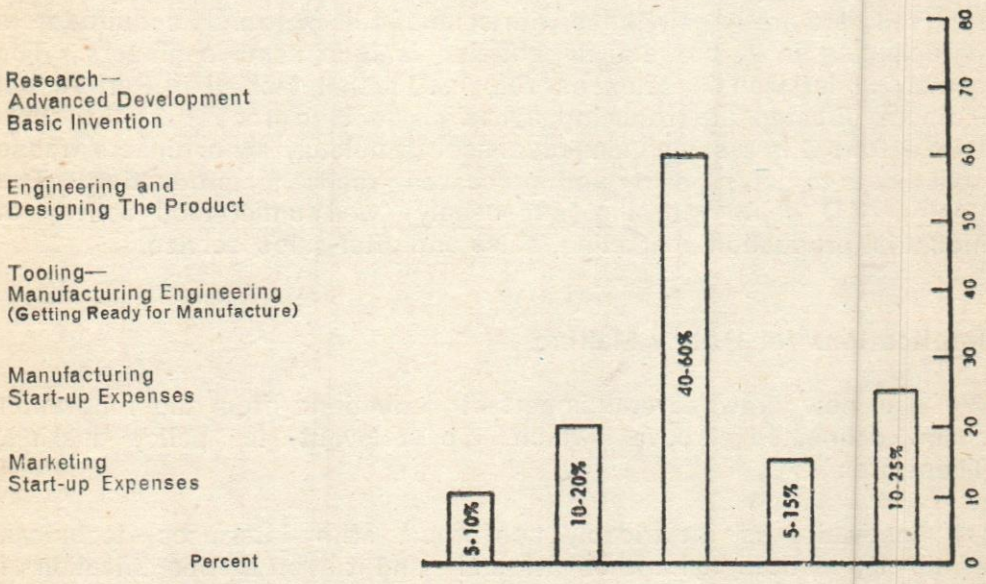
(2) The fact that administrative control over each section in the chain frequently lies in different hands makes such interfaces often 'no-man's lands'. This requires that, at least in the early stages of the development of an industry like electronics, the innovation process as a whole

must be conceived, planned and executed by a single overriding managerial authority.

(3) The activities in the chain are by and large sequential in occurrence but overlap considerably on all the three counts mentioned in (1) as well as in regard to time. This provides some scope for undertaking activities in parallel also, thereby shortening total innovation lead time.

(4) Each activity will take a certain minimum amount of time, no matter how large an investment in men and money is made on it.

Chart 2 : **Typical Distribution of Costs in Successful Product Innovations**



(5) The time-phasing of the various activities in the chain plays a crucial role in ensuring that the innovation is successful.

(6) There is a 'Resource Threshold' in terms of annual outlay on men, equipment and materials for each segment of the chain which must be crossed if the project is to move to the next segment in any finite time interval.

(7) The magnitude of such threshold level resources required to complete each activity is far from uniform across the chain, but will generally increase as one moves towards the final stages of the chain.

(8) While the ratio between resource requirements for various stages in the chain will vary from product to product, studies have shown that in a majority of cases the distribution of costs across the chain is typically as shown in Chart 2.

(9) The kinds of training and aptitudes that the manpower deployed in each of these stages must have varied considerably, particularly in regard to specialisation. The development of manpower must therefore be undertaken keeping in mind the nature of the activity which each type of professional is to be deployed on.

Causes for Our Failure

Once we have accepted the concept of the innovation chain, recognised its inherent characteristics and perceived their implications for technological policy, it is relatively easy to see why the resources the Electronics Committee and the departments with interest in electronics have been committing to research, design and development have not succeeded in giving us a broader and deeper base of manufacturing knowhow.

First, while the innovation chain concept is known to policy makers in a theoretical way, no attempt has been made to use it in real life decision-making. Moreover, at the so-called operational level of managers in industry and project leaders in D & D laboratories, there is often a lack of awareness of even the existence of such a chain. As a consequence, the fact that interface problems are bound to come up at some stage in the development of what starts off as a D & D project in a laboratory has, time and again, been recognised only when the laboratory claims it has completed its task but no manufacturing unit is willing to undertake commercial production, or the user denies that his needs have been met.

Secondly, the features of the institutional structure available to us in this country for producing technological innovation, viz., physical

separation of institutions responsible for various stages in the chain, lack of the most rudimentary information system on needs, production programmes underway, development projects in progress, etc., militate strongly against essential prerequisites for successful innovation.

Thirdly, much of the success of technological innovation and, more narrowly, of goal-directed D & D, depends critically on our having the ability to make demand forecasts with increasing accuracy. I might stress that by this I do not mean such assessments as the money value of the requirements of computers over the decade 1970–80 ! Demand forecasts in such terms are useless operationally. To provide an important input to promoting technological innovation, demand assessments will have to be reduced to product-specific terms. Such demand forecasting is difficult, and calls for the use of sophisticated statistical techniques. But the fact that for at least 60 per cent of the electronics needed over the coming decade, government will be the sole purchaser, should make things much easier. It must be emphasised, however, that equally important as having such a forecast at all is its availability sufficiently far in advance of the time when the product is first needed, to enable not merely D & D but also the remaining stages in the chain to have adequate lead time. Far too often in the development of electronics during the last four years has the demand forecasting effort started, or the demand made available to the Electronics Committee by the concerned government user, only when an offer for import of technology has been received from a foreign company or, worse still, when clearances for the import of the product itself are being sought. Thus development of use–directed domestic technology is repeatedly pre-empted.

Fourthly, both industrial units and laboratories in electronics are extremely weak in production engineering capacity, and indeed persons trained in the design, development and engineering of production machinery, jigs, tools and fixtures are extremely small in number. This has proved to be a major bottle-neck in ensuring that process know-how or product design, once proven on the laboratory scale, i. e., brought upto stage 6 in the innovation chain, can be carried forward to the next two stages, viz., engineering of production protoypes and designing and fabricating of equipment enabling volume production. A typical example is provided by the case of silicon, where the mono–crystalline

silicon pilot plants at both SSPL and Electronics Corporation of India Limited (ECIL) are being equipped almost completely with imported production machinery.

Fifthly, the very fact that the overwhelming bulk of our electronics output today is based on foreign technical collaboration has prevented manufacturers from having to face the difficulties of true technological innovation. Under a collaboration agreement the foreign company usually provides the following inputs :

(a) full complement of production equipment :

(b) detailed plant layout and either written instructions or its own personnel for installing and commissioning production machinery;

(c) details of production process, with blue-prints, production drawings, testing and approving procedures;

(d) bill of materials for product;

(e) training at their plant of our staff who are to supervise production and the testing and control of quality, volume, etc.,

(f) training of workers for various operations through the deputation of one of their foremen or equivalent production operatives to this country; and,

(g) consultancy services to overcome teething troubles.

These inputs correspond to a considerable transfer of resources, but only those related to stages 8, 9 and 10 of the innovation chain. This does not mean, of course, that the collaborator did not himself go through earlier stages in the chain, particularly from 4 onwards. But that experience is never communicated in the transfer process, even implicitly. Consequently, when presented with Indian technology which has only come as far as stages 5 or 6 the manufacturer is reluctant to commit the men, money and intellectual and managerial resources needed for him to learn how these stages are performed. This is particularly so when he is sure that he can continue to rely on 'packaged' technology from abroad on a continuing basis.

Essential Elements in a New Strategy

How then should one proceed if the electronics industry is to move out of this unsatisfactory state of affairs in regard to technological innovation? To be sure there is no unique formula, as different detailed strategies will have to be evolved and applied products ranging from computers to microwave communication systems and electronic materials. It is possible, however, to identify in the light of our experience hitherto a set of initiatives which an apex body like the Electronics Committee or a proposed National Electronics Development Board can take immediately to set things right.

First and foremost, such an apex body and, within their delegated spheres of responsibility, the government agencies, must see themselves as very much more than disbursers of funds for D & D. The apex body, in particular, should assume the global role of 'manager of technological innovation' in electronics.

To fix our ideas let us consider the case of a Sophisticated Electronic Test Instrument on which a D & D laboratory wishes to work and for which it approaches the national apex body for support. Here the paramount factor shaping the product chosen—its technical specifications, the process involved in its production and its end use—is the amount of information available to the D & D group (on both technical and commercial aspects) and the group's technical competence and interest. Were the D & D activity a self-contained one, the provision of such inputs might be deemed adequate for evaluatory decision making. But given the innovation chain, they are not. The apex body would therefore have to pose and secure answers to a whole range of wider questions, such as :

(a) what is the market for the product and how is it likely to develop in the future ?

(b) what are the criteria by which the technical success of the project will be assessed and by whom ?

(c) does the terminal stage of the project as defined by these criteria constitute an institutional interface in the chain ?

(d) assuming success, what forward action should the apex body or

others take to prepare for smooth transfer of technology across such an interface ?

(e) specifically, how much would the resources in men, money and time be to ensure that such transfer is supported at above the threshold level and is therefore likely to 'succeed' ?

(f) what would be the exact operational nature of the responsibilities of the two institutions of either side of the interface, e. g., a research laboratory and a pilot plant to be set up in a manufacturing unit ?

However, even the issues covered by these questions will, in many cases, not take one far enough. Particularly, in situations of the kind which face us in the country, viz., where a large part of the need for development-intensive electronics products is meant for government users, the apex body will have to go further down the chain than even the manufacturer and establish direct links with the user. There will then be a need to manage the transfer of technology (now as embodied in a product) across the producer-user interface. The questions to be posed will be different in substance but similar in character to those listed earlier. User acceptance will then have to be formalised appropriately. Only when all this has been done, can the 'innovation management authority' evaluate the adequacy or otherwise of the D & D project proposal which is all that it has in front of it to begin with. I think it is fair to say that such conceptual clarity, care and industry by a team of persons with a mix of technical, economic, legal and managerial skills has yet to be committed in the development and exploitation of indigenous electronics technology, whether by the Electronics Committee or indeed by any of the agencies. Thus, seeing that all existing projects are subjected to such an examination is a matter of the highest priority.

Secondly, a detailed review of professional electronics needs during the 70's and a forecast of the expected growth in consumer electronics products over the same period must be undertaken, at whatever cost in terms of men and money. Then, working in consultation with the professional electronics users, the apex body must draw up a list of priority products, the need for which must be met through indigenous technological innovation. Ranking these products in terms of their importance as judged by such criteria as strategic need, volume of requirements, and attainable technological sophistication, the apex body

should make the specifications of the products, the time phasing of their need and the design concepts to be used, known to both D & D laboratories and manufacturing companies. It should take the further initiative to establish, formalise and make mutually intelligible the responsibilities of these two institutions and of the users, in a multilateral co-operative endeavour not just of know-how generation, production or use, but of innovation. In this way the D & D institution, the manufacturing unit and the user will all be held accountable.

Thirdly, a major effort of analysis, decision-making and, above all, working in the field with manufacturing units in the engineering and machine-tool industry must be launched, to ensure that at least the plant and equipment required to produce the electronic components and materials needed for the industry during the 70's is fabricated and instrumented domestically. Unless this is done and done fast, more and more of our effort at earlier stages in the innovation chain will come to nought and the now familiar situation of process technology being imported even in cases where it has been successfully proven to the user, because the overseas companies supplying the plant and machinery required make the import of the process technology itself a condition for the supply of plant, will continue.

Fourthly, the apex body and the government agencies with major responsibilities in electronics have to build up on a most urgent basis 'technological innovation teams' whose full-time responsibility would be to structure, promote and manage the innovation chain in electronics. The members of these teams should be trained in a wide range of analytical skills ranging from demand and technological forecasting, to cost-benfit analysis, PERT, and other elements of programme planning and management. Their most important requirement, however, is to be able to work in the field, locating the interfaces and matching the activities straddling them.

As emphasised earlier, it is practically impossible to design a successful strategy for technological innovation on a global basis, particularly when, as in an industry like electronics, we have to deal with products ranging from specialised materials to large integrated systems. The five inputs discussed earlier must, therefore, be regarded as necessary but not always sufficient conditions for success. The range of factors to be included in any particular instance can only by decided

through carrying out, at both the national and the agency levels, a series of real life case studies on technological transfer and innovation.

It is in pursuance of this conviction that the Electronics Board of the Department of Atomic Energy has been undertaking such a case study during the last six months. The experiment involves a set of Microwave Test Instruments 'developed' by the Tata Institute of Fundamental Research. These Instruments had been brought to the stage of pilot plant production at the Institute by the time the matter of their commercialisation came to the attention of the apex body in this case, viz., the Electronics Board. The task before the Board was, therefore, to successfully carry out all the remaining activities in the chain. The experiment is still in progress and therefore no conclusive results can be given at this stage. However, many useful insights have been acquired and particularly difficult interface problems identified.

Conclusion

The need to 'produce' technological innovation poses a fundamental challenge for the development of our electronics industry, viz., to learn the behavioural, institutional, technical, economic and managerial intricacies of this process and apply the understanding so acquired in the policy making and executive arenas, or give up the resolve to develop an autonomous industry altogether.

Notes

1. However, see Brigadier K K Mehta's panel statement at the National Conference on Electronics held in Bombay in March 1970 (NCE-6) in which he has given a figure of Rs. 3 11 crores as the R & D outlay during 1969 on the 4 electronics laboratories in the DRDO.
2. "R & D Activities in Electronics" in "Electronics Information Potential in India", INSDOC, New Delhi, 1967.
3. See my panel statement at the National Conference on Electronics (NCE-7).
4. This figure is computed on the basis that :
   (a) the national D & D outlay in 1964 was Rs 4 crores ;
   (b) that starting from such a base level, attainment of an annual outlay of Rs 75 crores on D & D (excluding long range basic research) requires a compound growth rate of 34 per cent ; and
   (c) that at such a growth rate the outlay anticipated should be Rs 17.4 crores in 1969.
5. C Freeman : "Research and Development in Electronic Capital Goods". *National Institute Economic Review*, London, April 1965.

Exotic Technology and Performance of the Indian Economy : Key Areas of Failure

V. S. Mahajan

Quite often the exotic technology is blamed for the poor performance in a developing economy. This, one feels, is an unjust charge and needs to be repudiated. One can hardly think of a country which starts from a scratch. In the beginning every country has to borrow technology from some other (advanced) country for changing the traditional mode of production. History well supports this. Great Britain In the 17th century borrowed technology and skills from the Continental Europe ; and the Continental Europe, in return, borrowed liberally from Great Britain in the 18th century. This shows the circularity and feedback of technology. The USA borrowed liberally from Great Britain and the Continent in the 19th century (especially during the early period); and in the 20th century the USA has emerged as the world's largest workshop of technology and has been feeding the world market. Japan borrowed from the USA and the West in the latter part of the 19th and early parts of the 20th century, and Japan has now emerged as an important feeder of technology to many countries.

India, in the middle of the 20th century (especially in the 1950's and early 1960's), has been borrowing substantially from the USA and Western Europe (though earlier she was mainly dependent on Britain because of her political ties). From the latter part of the 1960's, India has been leaning on the Socialist countries (mainly the USSR) for the transfer of technology. It is because of continuous flow of exotic technology that India has been able to accumulate capital (especially in basic and capital industries) during the last over two decades at a rate it was never done in the past. It would have been unimaginable for her to produce steel, machinery, equipment, components and parts, and intermediate goods (including fertilizers, cement, chemicals) but for her having a liberal access to technology from the advanced countries. Thus the contribution of the exotic technology in her recent growth has been substantial.

This at the same time does not mean that India has made the best possible use of the exotic technology. In fact it is this part of technology that needs further probing, i.e., why India has failed to make an

optimal use of technology. It is not that imported technology is bad, but the fault generally lies in making an appropriate use of such technology. One has to pose questions such as : Does the exotic technology help to speed up the rate of local development ? Does it help to train local people so that in due course of time they could independently operate such technology ? More importantly, how far the imported technology is adapted to the conditions obtained in the importing country ? For instance, a developing country may be having abundance of mostly unskilled labour force and shortage of capital, while the exotic technology is developed under a different set of factor situation (scarcity of labour and abundance of capital). Thus to obtain appropriate results such technology would have to be adapted to suit the factor situation in a developing economy.

Adaptation of Exotic Technology

It is felt that the problem of adaptation of exotic technology to the conditions obtained in a developing country is of fundamental importance. Again the historical experience lends full support. The Industrial Revolution in Great Britain in the 17th and 18th centuries was the result of her people's ability to adapt exotic technology to the emergent national and international situation. The development of steam power became the main focus for the development of railways and steamships which enabled Britain to gain supremacy in international commerce over other countries. Putting it slightly differently, the development of steam power (which had its immediate impact on the development of coal mining) would not have gone very far if there was not sufficient feed-back in the shape of development of machinery and transport sectors (the main users of steam power in those days). Thus it goes to the credit of the British technicians that they were able to adapt new techniques of productions for accelerating their growth rate. In the 19th century, the USA was able to make far-reaching changes in both farm and industrial techniques and thus has emerged as the world's richest country in the 20th century. Japan which had borrowed the technology from the USA in the initial stages of her development had found that such technology was not suitable to her local conditions. For instance, she found that the machinery developed for big-sized farms was not at all suitable for her small-sized farms. It was also found that when Japan had employed foreign farm technicians in the

earlier part of her development, they were not acquainted with local conditions. It was through persistent effort and zeal of the local people (especially the administration) and giving time and sufficient incentives to foreign technicians that soon it became possible to develop new techniques suitable for the Japanese farms, and also because of efficient farm extension programmes, these techniques gained countrywide popularity. Japan also made a remarkable adaptation in industrial techniques and developed techniques which could suit her factor situation (abundance of cheap labour and shortage of capital). If today Japan is the world's best organised and developed country for small industries, it is in no small degree due to the ability of her people to develop suitable means of production after thoroughly mastering the imported techniques.

Recently China has shown how a backward country, containing the world's largest population and possessing limited natural resources and capital could forge ahead of all developing countries through sheer determination and ability of her people to adapt exotic techniques to their local conditions. It is well known that for the first ten years of her development, after the founding of the Republic (in 1949), China was exclusively dependent upon Russia for technology and technicians. However, she used this opportunity for the maximum assimilation of the new technology and for training her people in new methods of production. In fact, such was the rate of assimilation of exotic technology that after 1960, there was no need for the foreign technicians in the country and they were sent back. By the middle of the 1960's, China was depending upon her own technicians for the operation and maintenance of all imported plants. Not only this, simultaneously her technicians were busy developing alternative techniques of production which could suit local conditions, i.e., developed techniques which could meet the need of small farmers and scattered rural population which formed nearly 80 per cent of her total working population.

Let us give a concrete example. It was found that while large (exotic) cement plants were all right for feeding urban areas, these were ill-suited for feeding the needs of rural areas. And if industry was to be decentralised—which was the only way to contain population in rural areas and avoid their shifting to already overcrowded urban areas—rural areas should have a sufficient quantity of cement for the construction of small industrial complexes as well as for building rural houses,

farm buildings, schools and community centres. Thus, through continuous effort the Chinese technicians were able to develop small-sized cement plants which could be set up in rural areas without difficulty and which used local inputs. In fact, it is said that at present over half of the total cement produced in China comes from these small plants and the rest from the big-sized plants. This is an isolated example showing how an important basic item like cement is produced in China and how it has helped to speed up construction in rural areas as well as made life of the rural population more comfortable and happier.

Performance of Exotic Technology in India

Unfortunately in India, despite 25 years of planned development, it has not been possible to develop technology to suit her own conditions In other words, India has failed to develop alternative techniques which could have helped her to accelerate production and employment. The development of suitable technology in the farm sector which could adequately meet the requirements of small farmers is still a far cry ; e.g. while India has emerged as the world's important manufacturer of tractors, these tractors continue to be prototypes of Western tractors and the country has failed to develop small tractors (or even hand power tillers) which could cater to the needs of small households.

India happens to be the world's second rice grower (and rice also happens to be the staple diet for the majority of her population), but the yield per hectare continues to be very low. This shows that her farm scientists have failed to develop high-yielding varieties in rice as well as technology suitable for rice cultivation. In electric power, India still depends heavily on the outmoded equipment which also has a high import content. Much of the present power crisis could have been averted if the country had developed her power equipment, especially of the type which could cater to the needs of the rural population.

In the industrial sector, the situation is equally gloomy. Most of the equipment in basic and heavy industry is of complicated nature. Despite years of functioning, these plants continue to be dependent on foreign technicians for their operation and maintenance. Further, most of these plants operate below capacity, thereby entailing a huge waste to the

national exchequer. Thanks to the present communication and marketing facilities, basic goods are only available in urban areas and not in rural areas, though 80 per cent of India's population lives in rural areas. This partly explains the paradox that while India has a huge domestic market most of the plants continue to operate below capacity Further, the domestic market is so scattered that it could be approached effectively through the development of new techniques of production which could help de-centralisation of means of production. We have already considered earlier how China has de-centralised the production of a basic industry (cement), through developing small-sized plants. Unfortunately, India has done nothing of this type. Cement consumption in this country is confined to urban areas and rural areas generally do not get it. Under this situation, it would be no more than wishful thinking to develop the rural sector.

Thus, the conclusion is inescapable that while India has borrowed exotic technology heavily over the last two and a half decades, she has yet to adapt this technology to her own conditions. There is no self-reliance in technology. Rather in this matter the country is very heavily dependent upon Western and Socialist countries. That such dependence is not a healthy sign (i.e. exotic technology is not suitable to India's conditions) is reflected in the poor performance of the economy—one important indicator of this is that the country has had just half the growth rate in national income than what has been planned under various Plans. Not only this, the decennial average growth rate (in constant prices) is unfortunately declining. Thus, if India is to have the minimum of 5 per cent growth rate—which is not ambitious either—it would have to adapt suitably the exotic technology to suit her factor situation. This would need political will and concerted effort of both technicians and administrators.

Readers' Page

In January-March 1975 issue of PRODUCTIVITY, K. Kasturi, in his paper "Small-Scale Industries : Too Much of Feather-bedding ?" has accused the small entrepreneurs of becoming "a much-pampered lot". He says, "but the peculiarities of our support system only encourage the infant to remain infant, clamouring for increased support all the time. Under an ideal system, one would expect the small industrial units to benefit from the props offered, grow in strength and cease to look for support". (Page 412)

I have only to point out to Dr. James J. Berna's book "Industrial Entrepreneurship in Madras State" and to the comment of Eugene Staley : "This proves that it is at least possible for small-scale industry in India to serve as a seedbed for medium scale industry, and it justifies further the efforts being made by government of India to provide small-scale manufacturers with better opportunities for access to modern technical and managerial knowledge and to the financial and other requisites for growth".

Mr. Kasturi is unduly concerned with official patronage to small industry.

—Amarjeet Singh,
New Delhi.

Book Reviews

PERT and CPM Principles and Application

L.S. Srinath, 2nd Edition

East-West Press, 1975, Rs. 25.00

Reviewed by Rakesh Kumar*

Any student of management can hardly quote a few Indian books in the field of management he can be proud of. 'PERT and CPM Principles and Applications' is one such book written by L. S. Srinath, Prof. of Mechanical Sciences, Indian Institute of Sciences, Bangalore. The second edition of this book appears to be more presentable in its present get up and format. Two more chapters have been added, one on 'Linear Programming and Critical Path Scheduling' and the other on 'Problem Formulation for Computation'. Other new features include the division, with modifications of the original chapter nine into two chapters namely, Resource Allocation, and Management and Network Analysis.

Mr. Srinath has mentioned in the preface, 'the technique of PERT and CPM are being extensively used to solve not only phenomenal problems, such as those connected with missiles and space travel, but also simpler problems costing only a few hundred dollars. The objective of this book is to explain what PERT and CPM are and how they can be profitably used to solve such management problems'.

The book meets its objective partially as it does explain what PERT & CPM are and how to solve problems costing only a few hundred dollars, but it is silent about the applications of PERT in phenomenal problems. PERT and CPM techniques of drawing networks have been methodically discussed. All aspects of computation on networks have been covered including time estimates, costs and resource levelling The book also contains a brief write up on the various statistical principles used for computing various parameters on networks. In all, there are twelve chapters and each is accompanied by a set of problems for practice. The solutions too are given at the end. The book, in its present form, is a comprehensive text and there exists scope for introducing some real case example. While going through this book whereas one gathers information about the network techniques, one remains ignorant about the problems encountered in planning and execution of projects in the field.

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It is, therefore, suggested that in the next edition of this book, some case studies with special reference to India from the field on application of PERT may be introduced. This will make the book more practical-oriented.

Computers have proved very useful in PERTING big projects and package programmes are available. This book has altogether omitted to discuss the application of computers in PERT. While the introduction of chapters on Linear Programming and Critical Path Scheduling and Problem Formulation for Computation is a step in this direction there is a need to lay emphasis on computer applications without which PERT could not have gained the importance it enjoys today.

In short, Srinath's book is an excellent introduction to the techniques of PERT and CPM. The book can serve as text-book for the students of management science. It is useful for anyone who wants to acquire basic understanding of PERT and CPM techniques, be he a project engineer, planning manager or any other executive.

Fundamentals of Business Organisation and Management

Y.K. Bhushan

Sultan Chand & Sons, Delhi, 1975

Reviewed by Dr. G.R.S. Rao,*

This publication (8th edition) coming from an author with wide experience, is primarily addressed to the student community and on that score, has been subsidised by the Government of India.

The text-book approach is fairly reflected in the coverage of topics which include Business System, Business Ownership and Size, Company Management, Business and its Environment, Principles of Management, Production Function of Management, Personnel Function of Management, Marketing Function of Management, and, Financial Function of Manage-

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ment, in as many parts—which are grouped into two volumes.

The first part sets the problems and prospects of business, what may be called the 'National-Political' perspective which constitutes the environment within which business organizations operate. However, viewed in the context that is primarily meant to serve the student community, a glaring vaccum in coverage appears to be the absence in the theme of the volume a cross-cultural perspective – role, philosophy and structure of business organizations in capitalist, socialist and other shades of social systems. Treatment of the problem in a cross-cultural context would enable the readers to appreciate not only the emergence of the wide range of theories, but also an of the divergence among the available body of theories. Whereas such a cross-cultural perspective provides a rationale for specific approaches and policies, the absence of such a perspective makes knowledge of particular approaches.

This cross-cultural perspective is also essential for students in the context of growing strength of multi-national corporations, which necessarily have to take divergent and often conflicting socio-economic system and cultural contexts.

A distinctive feature of the publication is that the material presented in the book merely end up with a review of the body of theories but also fairly elaborately covers policy. The advantage of such a coverage would have been enhanced had the author also covered and explained with the aid of examples and dates the wide range of divergence in actual practices.

The language is simple and direct and the print is good, although not without its quota of printer's devil.

The basic limitation, however, is with regard to heavy reliance on theoretical base which is alien to the Indian context, and absence of an explanation of the consequent incongruence. Absence of an attempt to review the Indian situation vis-a-vis the incongruity exposes, at least in part, the student community to distortions in perception and appreciation of the subject matter in a proper and broader perspective. However, this is a problem that is common to most of the publications—the present one is no exception.

Planning, Development and Economic Policy in India

V.S. Mahajan

Kalyani Publishers, Delhi, pp. xvi +340, Rs. 36.00

Reviewed by C.V. Rao*

The subject of economic planning for a moderate rate of economic development for any nation depends mainly on the policies adopted by them. But this is not the end in itself. Clear-cut objectives, judicious selection of priorities, line of action, their implementation, overcoming the bottle-necks in an effective manner, and more importantly, stepping up the rate of growth of productivity in a variety of sectors do contribute positively towards an accelarated rate of growth of the economy.

We, in India have had enough experience of plans and planning models since independence. More so, every plan was ambitious at the start and ended up with more negative points than plus points, thereby presenting a gloomy picture. Unfortunately, none of the Five-Year Plans in India, have been able to fulfil the objectives laid down from time to time. Though the nature of disappointment hardly varied, the degree of gloominess varied from plan to plan.

There are many writings to date to assess the success and failure of Five-Year Plans critically, and the book under review is also one of those which has added something for researchers to chew for some time. Without saying it explicitly, Mahajan has adopted an inter-disciplinary approach, but does not clearly state how development takes place and what are the various characteristics of economic backwardness which are inter-related and complementary to each other. This is important because planning is always preceded by a dig into the developmental process and on the basis of the study of this process the conventional theories of development are replaced by modern theories of development.

The book is spread over seven parts and 18 chapters. Part I deals with the development process during the Plans and has not much to contribute to the earlier criticisms provided by most of the writers.

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Part II deals with one of the most important sectors of economy—Agriculture. It is true that agriculture provides a good indicator for judging the growth rate of an economy. But it is realised that in spite of the increase in per capita availability of food-grains, increased production, better use of fertilisers and pesticides, etc., have not contributed much towards so-called *Green Revolution*. There has been considerable increase in production of wheat or rice but the production of other food-grains has, by and large, increased marginally. More so, it has been shown that the Green Revolution has not spread over the whole country but has resulted in an intensive cultivation rather than extensive, and the concentrated areas are Punjab and Haryana. Besides this, according to Mahajan, "The fruits of Green Revolution are pocketed mainly by rich and prosperous farmers and the disparity between them and have-nots —particularly landless agricultural labourers - has increased." (Page 49). Thus, in order to come closer to the socialist reality, new strategies for agricultural growth have to be adopted.

As far as the policy goals and their fulfilments are concerned, the author has rightly pointed out the drawbacks of community development programmes, national extension services, role of gram sahayak, panchayati raj, etc. and feels that progress cannot be made in the agricultural sector unless stiff policy instruments and better control over the functioning of these programmes and services are adopted which would provide a sense of confidence and enthusiasm among marginal farmers and agricultural labourers.

Another important sector—Industry, has been segregated into small scale industries and medium and large scale industries and have been discussed at length in the light of the Industrial Policy. One might agree with the author that the size of the investment in this sector is not that important, whereas, the nature of investment plays a decisive role. In dealing with a crucial subject like Industrial Policy towards large-scale industries, the author's analysis suggests that the government is justified in extending the field of public enterprises for rapid industrialisation and exploiting those areas which do not attract private enterprise. In doing so, Mahajan has mixed up some of the fundamental issues relating to a balanced approach for development, but has failed to provide a serious discussion on Industrial Policy.

According to Mahajan, the organised consumer goods such as cotton

textiles, sugar etc. have reached a stage where further growth of demand for their products is bound to be slow. Hence, the government should devote more attention to capital industries and allow consumer industries to organise themselves as per the market situation. Firstly, the above two mentioned facts are not compatible, and secondly, the latter is not a worthy suggestion. This is because, as is known, the use of inappropriate technology and production of non-essential products can at times change the consumption pattern in an economy like ours. Moreover, one cannot pass a sweeping judgement that cotton textiles and sugar industries have to be ignored. The reviewer firmly believes that either the actual demand for these products have not been estimated, or the author has ignored the untapped domestic market. Instead of ignoring such vital consumer industries, the government, with some extra efforts, can revive them and regain the lost foreign market for cotton textiles and compete as equals in the world sugar market.

In a separate chapter on Public Sector Undertakings, though Mahajan strongly favours their growth, he has rightly pointed out their teething troubles, (which are well known). To carry the discussion a step further the reviewer feels that unless the public sector undertakings are given full autonomy, control over finance, and a fair chance to compete with private enterprises, they are bound to meet with failure, and the whole exercise of developing public enterprises would be futile.

Part V, deals with Trade. The ever-widening gap in balance of payments will continue as long as we do not make ourselves self-sufficient on the agricultural front. This is because the import of food-grains every year constitutes a major part of the total imports. The reviewer is of the view that (a) drastic control on food-grains imports, (b) reducing imports of luxury items. (c) improving exports of traditional goods such as Jute, Cotton textiles, Tobacco, Sugar, etc. would help in reducing the balance of payments gap.

Transport, a media for communication, forms an essential part of infrastructure (dealt with in part VI). A transport economist would be glad to see a section on inland waterways as a mode of transport. Though the author has given the horse power ratios of the various means of transport via land, railways and water as 1 : 10 : 70, it would have been better had he estimated their cost of carrying goods per-tonne-per kilometre. NCAER has conducted one such study, (the reviewer was

associated with the study) and has suggested that waterways is the cheapest mode of transport.

The seventies model, in the light of IV Plan and V Plan approach paper has been presented in the last part. All said and done, one feels that whatever were the problems in the beginning still remain and they vary only in magnitudes.

To conclude, the book is well written, of course, there are repetitions too. Had there not been any *In Brief* or *Summaries* after every section or chapter, the book would have been neat and compact in its presentation. One would submit, that Mahajan has taken pains to substantiate wherever required. An adequate bibliography and an index at the end makes it a complete book.

Modern Business–Its Organisation and Management

(Ninth Revised Edition)

Satya Saran Chatterjee

World Press Pvt. Ltd., Calcutta, 1975, pp. xv +635

Reviewed by K. S. Sastry*

The book under review is a classic by itself. Though the title is Modern Business, the material carried proves the other way. In the preface to the first edition, the author says, "There are several books. . . . , they do not satisfy the general reader because of their academic bias. . . . . This has encouraged me to write a standard book on Business." The author of this book is of the view that it is helpful for "Students of Business in Professional Studies." But one may aptly put this book as 'Guide' to the Intermediate students of Commerce,

Spreading over 37 chapters, and classified into ten parts, this book carries with it usual bibliography and an index. One should submit here

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that the bibliography is useful to "students of Business in Professional Studies."

Part I which deals with the introduction on 'Business' is not new and can be found in most other books. Besides this, second chapter "Significance of Organisation, Management and Control" is almost the same as described in the author's other book, 'An Introduction to Management – Its Principles and Techniques'.

In comparing management with that of human body, the author has failed to convey the meaning; for instance, "The entire body, while planning is the brain, organisation constitutes its nervous system, direction makes up its respiratory organs and control stands for human mind" (page 22), the reviewer fails to distinguish between 'brain' and 'human mind'. Perhaps, this comparison is unsuited in this context.

Part II consists of 3 chapters dealing with the elementaries of Business, viz., sole proprietorship, partnership and companies. Part III has been devoted to Company Laws. But instead of a chapter on Office Management, a chapter on Companies (dealt with in part II) would have been more appropriate in part III. Part IV has nothing to add new to the existing literature. It is heartening, that a note has been provided on 'The Concept of Productivity and the Productivity Movement in India' which is the need of the day. Unfortunately, the author has described what productivity is, but has failed to provide an approach to measure productivity.

Part VI which deals with Financial aspects like capital structure, financial market, special finance and development corporations, etc., the author has avoided delicate issues like 'depreciation'. Manufacturing Activities, which is dealt with in part VII, includes—'Plant Location, Layout and Building', 'Production Control and Methods Engineering' and 'Purchase and Store Keeping.' But one wonders whether Plant Location, Layout, etc., are manufacturing activities. A subject like Automation has not been mentioned even, which forms an important Integral part of 'Manufacturing Activities'.

Part VIII deals with 'Personnel Activities'. "At long last labour participation in management has been found to be a cure-all remedy for solving problems of industrial relations in India" (page 432). Unfortu-

nately, there is no evidence fresh or otherwise or a convincing logic to establish the validity of the statement.

The remaining two parts deal with 'Marketing Activities' and 'The Role of State in Business'. In the former, on an interesting topic like 'Advertising is Wasteful', the author has failed to provide a comprehensive discussion, whereas in the latter all the aspects mentioned in earlier chapters have been grouped together and dealt with under the heading 'The Role of State in Business'.

To conclude, though the author has taken pains to include as many topics as possible on the subject of Business, he has failed to provide concrete answers to the variety of problems already existing. The reviewer fails to evaluate the contribution made by this book to the body of literature available and feels that the author has fallen short of his target in producing a standard book which is not strictly academic bias. Obviously, this book can be considered as a handbook on 'Business'.

Short-Term Investment Fore-Casting

—An Exploratory Study

Samuel Paul & C. Rangarajan

(I.I.M. Ahmedabad)

Published by Macmillian Company (India), 1974, Pages 207, Price Rs. 50.00

Reviewed by N. Varadan*

The pivotal role of investment in the matrix of economic forecasting needs no emphasis. Forecasting usually is either for long-term or short-term. In most mature/advanced countries, not subject to much political pulls and pressures, long-term forecasting may be quite appropriate. But in a country like India, preparation of cash-flows more than a period of five years is quite jejune. The book under review is one such study, pertaining to a country like ours, where short-term forecasting alone becomes at once relevant and meaningful.

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Bearing in mind, presentation of a unified model for investment forecasting bristles with practical difficulties, the strategy of presentation has been attempted in the following manner :

Chapter 1—deals with the existing literature on the subject ;

Chapter 2—highlights the problems of forecasting plant and equipment expenditures in India;

Chapter 3—focuses attention on the forecasting of construction expenditures;

Chapter 4—spotlights the capital consents and investment in corporate sector;

Chapter 5—analyzes the sources of funds and investment in corporate sector;

Chapter 6—discusses forecasting corporate investment with the data of term-lending institutions;

Chapter 7—projects the predictive performance of Government budgets;

A case-study (pertaining to Gujarat State Electricity Board) is also presented at the end.

Investment forecasting refers to the forecasting of gross fixed investment in the economy. Net changes in inventories have been excluded from the study. Gross fixed investment means Plant and Equipment and Construction. Again, construction can be divided into residential and non-residential. The study is limited to the organized sector of industry in the economy. Investment has been treated as an autonomous component.

Any attempt at the estimation of functional relationships for forecasting fixed investment in India, will have to be brusquely brushed aside due to the fact that the play of market forces, the data limitations and the nature of the independent variables not being of a lagged type delimit the scope of study.

The divergence between *ex ante* and *ex post* investment, with investment intention being kept in the silhouette, has been neatly tackled by the authors.

The unique contribution of the authors which runs demiurge throughout the book is the analysis of the Lag Structure. Orders refer to the firm commitments made by the investors. Orders are a useful predictor only if there is a systematic time-lag between the placing of orders and the occurrence of investment. But lags vary due to ever so many reasons. A detailed study has been made in the book with reference to different types of industries. A conceptual framework is sought to be provided by the authors with the help of the statistical techniques like regression co-efficients and testing of hypothesis. More detailed workings could have been given so as to make it understandable to the layman.

The authors have overemphasised the impact of backlog of orders. Different writers treat this differently. A more sophisticated approach may be to treat the backlog of orders as fresh orders for each year ! The authors themselves are very sceptical about the influence of 'Backlog'. Unless a systematic time-series analysis is done, as authors themselves opine, (which is shared by the reviewer also) no tangible outcome can emanate out of this research.

Turning to construction expenditure forecasting, a detailed discussion is given on the employment of behavioural models, the nexus between the permits and completion of contracts and other critical variables. Quantification of these influences and prediction of construction trends with the aid of econometric models give room for freshness of approach.

Authors answer the pertinent question raised by some, about the usefulness of forecasting construction with the aid of permit data If the mix of buildings does not change substantially over time, permit and completion data may reflect the movements in construction activity reasonably well. Once a series on construction expenditure becomes available, the ability of the permit series to forecast construction expenditures may be tested. It must be remembered that there is no particular lag structure as the most appropriate in a given situation between permits and completions. Despite data limitations, the authors

have been able to give cogent evidence of the influence of lagged permits on completions. Financial and organizational factors may not be that much important in explaining the variability in lag structures.

In the chapter on 'Capital Consents and Investment', an attempt has been made to forge a link between capital consents and capital raised. Capital raised in a year was regressed on capital consents of the same and the previous years. The best lag structure was obtained when capital raised in a year was related to capital consents of the same year and the previous year. The impact of the injection of additional variables has also been tested.

In the context of Sources of Funds and Investment in Corporate Sector (dealt with in next Chapter) the link between capital formation and the anticipatory data relating to external finance has been traced. The linear regression of capital formation on capital consents *plus* loans sanctioned of the previous period gives the co-efficient of determination. It was found that the fit of the equation does not improve with the addition of capital consents and loans sanctioned, with a lag. (The term 'Regression' is a misnomer in this context. 'The Line of Best Fit' serves the purpose).

In the chapter on 'Forecasting Corporate Invesment', the authors bewail that though the project proposals are screened by the term lending institutions at the time of granting of loans, no adequate *post mortem* examination is done. The total value of project may have to be revised or proper phasing of capital expenditures is necessitated. This has been the practical experience of the writer, too. It is heartening to note that recently research studies have been started by some financial institutions on the aspect of cost over-run in project implementation. The authors may, perhaps, well elaborate upon this in their next edition.

The price of the book alone is rather prohibitive and beyond the reach of the middle class intellectual elite.

The authors deserve high praise for ushering in new ideas and provoking creative thought—an additional milestone to the existing body of knowledge—'Fresh woods and pastures new'.

ILO Conventions and India

Dr. N. Vaidyanathan,

Minerva Associates, Calcutta; 1975; Rs.36.00

Reviewed by R. V. Mathai*

After Dr. P.P. Pillai's book, 'India and the International Labour Organisation', which appeared in 1931, Vaidyanathan is the first Indian scholar to attempt a comprehensive treatise on ILO and India. During the last few decades, and, particularly, since the Declaration of Philadelphia (1944), the aims and purposes of the International Labour Organisation have undergone radical change. The size and composition of the organisation have also changed in appreciable measure. In the area of its main task of standard setting in regard to labour matters the ILO has, in the context of revolutionary industrial technologies, adopted more than a hundred each of new Conventions and Recommendations, about a four-fold increase. More significant than numerical increase has been their dimensional change. There have, no doubt, been several piecemeal efforts through official reports and articles in labour journals, highlighting some of the special aspects of this change; but a comprehensive, critical appraisal has been long overdue. Dr. Vaidyanathan deserves credit for ably filling this void.

The key-note of Vaidyanathan's doctoral thesis is a critical examination of the Conventions regarding Social Security, Man-power Planning and Employment and Human Rights in relation to their impact on and interaction in India. He deplores the unrealistic manner in which most of the Conventions are framed, paying scant regard to multifarious problems and numerous difficulties which a large majority of the States comprised in its membership, especially those on the theshold of or in the process of development, are likely to face in attempting to implement them. It would appear that the ILO is concerned, almost to the point of an obsession, with the exactitude and textual perfection of the instruments than the accession of the large majority of the members to these instruments. The author's careful analysis of the difficulties and problems encountered in India in ratifying many of the Conventions should be of interest and concern to those dealing with

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these matters not only in this country but also in several other developing countries where the problems are more or less similar. A pointer for more purposeful action for governments of developing countries is shown; but more important, guidelines are indicated for the ILO itself to mould the instruments in a manner more realistic and down to earth.

The Indian procedure for examination, ratification and review of Conventions has been elaborated. The ILO structure, objectives and functions, its operative fields and procedures have been described in the introductory chapter. The extensive documentation and cross referencing testifies to Vaidyanathan's pains-taking thoroughness. Ex-president Shri V.V. Giri's Foreword adds lustre to this publication. Accession of the book is sure to enrich libraries of teaching and research institutions and of workers' and employers' organisations.

Development of Marginal Farmers and Agricultural Labourers

S. M. Pandey

Shri Ram Centre for Industrial Relations and Human Resources, New Delhi, 1972.

Reveiwed by R. K. Sharma*

During the Fourth Five-Year Plan a provision of Rs. 150 crores was made for initiating two special programmes for enabling the rural poor "to participate in the process of development and share its benefits". One of these programmes (viz., Marginal Farmers and Agricultural Labourers Development Agency or MFAL) was initiated in 41 districts for the development of the most vulnerable sections of the rural society, namely the farmers owning less than one hectare of land and the landless agricultural labourers. A lot of official data are available to show the progress of this programme in terms of expenditure, coverage of farmers and the amount of credit distributed etc. These data, however, do not throw light on some of the important aspects of the programme. For instance, has the MFAL Programme served

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the purpose for which it was started ? How far the benefits of MFAL have gone to the really vulnerable sections of the rural poor ? And what has been its impact on the levels of incomes and employment of the marginal farmers and labourers ? S. M. Pandey's study is a commendable attempt to answer such important questions with specific reference to the MFAL programme in Mathura District of Uttar Pradesh.

The study is based on a sample survey of 338 households in two selected blocks of Mathura district where MFAL was initiated during January 1971. In this study the author has analysed in detail the impact of MFAL on income, employment, occupational structure, expenditure pattern and debt position of the selected marginal farmers. In addition, he has made a critical evaluation of the working of the MFAL agency. In the end he has given some valuable suggestions to improve the working of MFAL.

A significant finding of this study is that the agricultural labourers have been virtually bypassed. According to the study only five labour households against a target of one thousand could get loans for the purchase of milch cattle. This has been largely due to the unwillingness of both the Commercial Banks and the Cooperatives to give loans to the landless labourers because they are unable to furnish the required security. The benefit derived by the landless labourers have been limited to some additional employment created by programmes of rural works. The neglect of landless laboures by MFAL is, however, of no surprise to the author. "That the landless agricultural labourers were unlikely to be immediate and substantial beneficiaries of the MFAL assistance was clearly indicated in several official documents". But one can ask as to why they were included in MFAL ?

As regards the marginal farmers the study shows a brighter picture. The various schemes under MFAL have helped the beneficiary marginal farmers to increase their employment and incomes, though not according to their expectations. In particular, the scheme for the purchase of milch cattle has been quite successful. By and large, the benefits of MFAL have gone to the genuine marginal farmers, even though the farmers belonging to upper castes have gained more than those belonging to lower castes. According to the author, this is due to the fact that "in the existing rural setting advantages of development schemes are likely to accrue more to people belonging to higher caste

groups".

The study reveals many disquieting aspects of the working of the Agency. For instance, nearly one-third of the selected non-beneficiary farmers were not even aware of the existence of MFAL. Besides, a larger number of the beneficiaries found the officials to be non-cooperative or indifferent. This is partly due to the prevailing attitudes and partly to the fact that the MFAL Agency has to depend upon the existing agencies for the execution of its scheme. The officials of these agencies find the work of MFAL an extra burden on them and, therefore, their involvement in the programme is marginal.

In order to solve this problem, the study has suggested the strengthening of the staff of the MFAL Agency and provision of some financial incentives to staff of other departments involved in MFAL activities. But more important factor is a change in the attitudes of the officials who continue to give preferential treatment to larger farmers. It was also observed that the Land Development Bank grant loans for minor irrigation only to those applicants who buy engines from specific dealers who, as alleged by farmers, sell sub-standard machines and also charge higher prices for accessories etc. Therefore, the study emphasises that "if the government is really interested in improving the conditions of marginal farmers and agricultural labourers then the attitude and loaning practices of cooperative societies and banks should be changed."

Industrial Cooperatives in India

S. C. Mehta

Atma Ram and Sons, Delhi, 1975, pp. XVI+323, Price Rs. 40.00

Reviewed by V.S. Mahajan *

While the Government of India has been very keen since 1951 to develop small industries for solving the twin problems of the country (a) mounting

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unemployment and (b) scarcity of financial resources, it is found that the steps taken to foster the growth of these industries on healthy lines have been inadequate. It is well known that small industries cannot be economically viable unless their size of manufacturing and operation is extended. Such extension of size would help these industries to reap economies of scale and thereby enable them to lower down their cost of manufacturing as well as help small industries on healthy lines. And here the formation of industrial cooperatives would provide an ideal solution to the economic viability of small industries. Through these cooperatives small industries would be enabled to have access to modern facilities particularly latest techniques of production, management and marketing which are enjoyed in abundance by large industries. Thus cooperativization would provide all those technical and financial benefits enjoyed by large industries and at the same time enable small units to retain their independent character.

Dr. S. C. Mehta is to be complemented for writing a book on "Industrial Cooperatives in India" a subject which has not attracted much attention. One would however hesitate to agree with the very first sentence on the blurb : "The present work is the first analytical exposition of the operation of industrial cooperatives in india " One gets lost when one looks into the table of contents. The book, which is divided into 21 chapters, does not follow a logical pattern. While chapter 2 is devoted to Cooperation and Industrial Cooperatives", the Role of Small Industries vis-a-vis Large Industries is taken up in chapter 4 and in between, Chapter 3 is devoted to "Industrial Cooperatives in Foreign Countries. Here the author could not have done justice to 13 foreign countries in about 10 pages. The treatment is pedestrian and does not follow any logical sequence. It would have been better if he had concentrated on two or three foreign countries, especially those whose experience could have been beneficial to India.) Chapters 6, 7 and 8 are devoted to "Profile of Industrial Cooperatives in India". Here the performance of All India Handloom Board, Khadi Commission and Village Industrial Societies (including Handicraft Societies and the Board, Coir Societies and the Board, Secriculture and Central Silk Board has mainly been dealt with. The author has again failed to make an in-depth study of these bodies. Chapter 9 is devoted to "Industrial Cooperatives in Various States". As usual, the author gives bare outline of industrial cooperatives in States. Here he should have either extended the treatment of industrial cooperatives in States to more than one chapter, or if he wanted to concentrate

on one chapter alone then he should have selected one or two important States.

"Operation of Industrial Cooperatives" is spread over six chapters (Chapters 10-12, 14-16). Chapter 10 deals with membership, capital structure etc. of industrial cooperatives, and chapter 11 is concerned with their administration. Chapter 12 deals with the procurement of raw materials. Chapter 14, 15 and 16 deal respectively with marketing; analysis of expenses; and accounting (like costing, budgeting, auditing etc.). These are the core chapters of the book and are comparatively well written and analytically sound. The author has gone deep into the various aspects of the operation of industrial cooperatives.

"Financing of Industrial Cooperatives" is dealt in Chapter 18. Looking at the performance of Cooperative banks, one feels doubtful whether the establishment of industrial cooperative banks, as suggested by the author, would serve useful purpose in helping industrial cooperatives. One feels that it is not the lack of finance which handicaps the growth of industrial co-operatives, rather it is the absence of scientific management and control in industrial cooperatives which is to be blamed for their poor performance. So, unless both management and control are toned up, finance would not be of much help in the growth of industrial cooperatives. "Cooperative Education and Training" find its place in Chapter 19. In Chapter 21 the author deals with "Some Case-Studies of Industrial Cooperatives".

The book thus covers practically all aspects of industrial cooperatives in India, though the reviewer feels that the author would have done better had he concentrated on crucial aspects of industrial co-operatives and analysed these in detail. He would do well to rearrange the entire material when the next edition of the book is published. On the whole, the book is extremely informative and should be read with interest by all those interested in the working of industrial cooperatives in India. It is a useful addition to the growing literature on Cooperatives in India.

[illegible] cost control is to ensure that actual costs correspond to planned costs. Failure to meet that aim results in the failure of the company to meet its required profit margin. The structure of the Handbook is designed to ensure that managers understand what cost control techniques are available to them and how they can be utilized within each department. Part one explains the nature of costs and the principles of

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cost control, while, Part two provides a variety of approaches and techniques of major importance in the management of costs. Part three demonstrates how to apply these methods to the office administration, personnel, R & D, manufacturing, purchasing, marketing and distribution functions. A glossary of terms and definitions completes this comprehensive and readable Handbook.

Financial Management of Production

Lock, Dennis

Essex, Gower Press, 1975, 253pp, £ 6.25

The key phrase in every manager's vocabulary today is 'Financial Management'. In production, perhaps more than any other functional area, the application of sound financial principles and techniques can be the corner-stone of a company's survival. Chapters on Financial Management of Production reflect this perspective, and focus attention on four major areas directly relevant to the production function :

(i) Elements of accounting ; (ii) Planning for production ; (iii) Cost techniques in production; and (iv) Controlling factory costs.

The chapters present, in a detailed and practical form, financial techniques such as budgetary control, cost estimating, value analysis and cost accounting. It examines specific production topics as well, for example, inventory costs, project appraisal and maintenance costs.

Information Systems for Modern Management

Murdick, Robert G & Ross, Joel E

New Jersey, Prentice-Hall, 1975, 671pp, $ 14.50

This edition gives description of methods and practices which form the basis of the present day computer-based information systems. This helps a manager, as well to plan pragmatically in co-ordination with the computer specialist. It also enlists the radical changes management theory and practice have undergone in the past two decades, particularly, in the seventies.

Manufacturing Organization and Management

Amrine, Harold, T. and others

New Jersey, Prentice Hall, 1975, 588pp, $ 15

Beginning with a discussion of the significance of productivity in manufacturing, this book traces the background of management, explores organization and planning, and then moves into manufacturing systems design—plant location and layout, manufacturing processes, methods engineering and work measurement. The section on manufacturing control deals with areas such as inventory, production, quality, maintenance and costs. A section on manufacturing relationships discusses the human and financial elements. Management requirements and appraisal of results are covered in the final section. The presentation of information on such a specialised subject is in non-technical terms and provides a complete view for persons not familiar with management of manufacturing.

Poverty and Income Distribution in India

Srinivasan, T. N. & Bardhan P. K.

Calcutta, K. P. Bagchi & Co., 1975, 551pp, Rs. 100.00

Brings together some articles on methodological issues arising from planning for removal of poverty, the patterns and trends in income distribution in India, and on evaluation of policies that have been pursued with reduction of inequality as an objective. While this volume is by no means a comprehensive study on the problems of poverty and income distribution in India, it is perhaps fair to say that it brings together most of the quantitative information on, as well as policy aspects of, income distribution in India during the two and a half decades of planning since independence.

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Industrial Capacity : Concepts and Measurement

V. T. Kale

In a capital-scarce economy like India, full utilisation of the capacity is of utmost importance for two reasons. First, the capital already invested in industrial plant and machinery should be utilised effectively; and secondly, maximum goods and services obtainable from these facilities should be placed at the disposal of the society.

Concept

Capacity utilisation means, that proportion of the total capacity which has been gainfully utilised for production of required goods and services. It is thus a ratio—usually expressed as percentage of actual production to the "capacity", and is mathematically expressed as :

$$\text{Capacity Utilisation (in percent)} = \frac{\text{Actual Production}}{\text{'Capacity'}} \times 100$$

While 'actual production' of goods and services is tangible and is easily seen and understood, 'capacity' is a concept which is not yet fully and clearly understood. 'Capacity' has different meanings for different category of people. In addition, there is a plethora of terms in current usage such as: licensed capacity, installed capacity, rated capacity, achievable capacity, attainable capacity, agreed capacity, targeted capacity, etc. The purpose of this paper is to clarify the mis-conceptions behind these terms and to build a framework of concepts for measuring industrial capacity.

What 'Capacity' Means

The concept of 'capacity' could be easily introduced through a simpler and familiar example. Consider a Cinema Hall having a seating capacity of 1,000 seats. It is not necessary that in all the four shows the hall would be full. Supposing that in noon show 60% of the capacity

is utilised; in matinee 85%; in evening show 97.5% and in the last show 57.5% of the capacity is utilised.

While capacity utilisation of the hall has ranged from 57.5% in the last show to 97.5% in the evening show, the overall capacity utilisation of the hall for the day has been 75%. Just as capacity utilisation of the hall for one day is calculated, it could as well be calculated for a week, a month or a year. However, longer the period or time-span over which the figure is based, more realistic and representative it would be. One could rely on such figures more than the one for a single show or a single day.

Time Horizon

It is essential that the time horizon over which utilisation of capacity is determined should be long enough. A figure based on shorter time horizon could be grossly misleading. It is not enough that utilisation of capacity of a plant is outstandingly good only for a day or a week, but it should be a sustained performance at high level over a long period. This will make the capacity utilisation figure reliable and meaningful.

Usually most of the business and industrial operations are reported over a period of one year. The time horizon for determination of capacity utilisation should, necessarily be extended over a year in order to fit with other business parameters. The time horizon for capacity utilisation calculations should therefore be one year.

Concept of Installed Capacity

The starting point for creation of capacity is that there exists a certain demand at present or there is a likelihood of increase in demand in the future. It is to fulfil such demand that capacity is created or installed. There is, however, an implicit assumption that the plant would, over a year, produce goods and services to meet the demand over the corresponding period. To illustrate, if the demand for cement were estimated at 4 lakh tonnes per year, 'capacity' which is capable of producing that many tonnes of cement per year would be created, barring fluctuations throughout the year. How this would be achieved is examined below:

The Stream Factor

Assuming, that 4 lakh tonnes of cement is to be produced over a year and that the plant would work all the 365 days in a year, the plant would be sized for a capacity of $(4,00,000 \div 365) = 1,096$ tonnes of cement per day, or, say 1,100 tonnes per day. But this is a crucial and difficult (if not impossible achievement) assumption that the plant is "available" and is 'on stream' for productive purposes 100% of the time.

But no plant or machine is so dependable that it may, at all times, be relied upon to be in operating condition. However perfect the plants and machinery are, they either break down occasionally, or have to be taken out of service periodically for inspection, cleaning, maintenance and overhaul. Heat exchangers get fouled up over a period of operation, scales deposit on heat transfer surfaces, refractories in furnaces etc. get damaged, eroded, boilers need cleaning, de-ashing and statutory inspection periodically. These and similar factors necessitate stoppage of the plant and, hence, loss of production during the corresponding period is inevitable and must be recognised and provided for in the scheme of things.

Such unavoidable factors should be considered at the time of sizing the plant. The plant size is determined by the expected "availability" of equipment for service, the latter being defined by the following relation :

$$\left.\begin{matrix}\text{Availability Factor} \\ \text{or} \\ \text{Stream Factor}\end{matrix}\right\} = \frac{\text{Hours available for service}}{\text{Total hours in period}} \times 100$$

A year is normally the period over which the availability of a machine/plant is measured.

Referring back, it is known that the cement plant will have a daily capacity of 1,096 tonnes per day, if it were to operate at 100% availability factor (AF). This would represent the smallest size of a plant to produce 4 lakh tonnes of cement per year. However, if the expected AF is about 90%, the size of the plant to be set up would have to be bigger by a factor of $\frac{100}{90}$, i.e. $1,096 \times \frac{100}{90}$ or about 1,220 tonnes per day

in order to make up the required production in lesser number of days. If the AF is lesser, say 85%, the plant size would be correspondingly larger. The daily capacity of the plant is, therefore, determined at the design stage itself by the two factors viz., the desired quantum of output from the plant per year and the availability factor of that particular plant in question.

External and Internal Constraints Influencing Stream Factor

Choice of appropriate AF (or the stream factor) depends upon the type of industry and the plant in question. The factors and constraints which determine the AF are of two kinds: external and internal. External constraints which affect the stream factor are peculiar to some of the industries and no amount of internal efficiency can alter the situation For instance, under Indian conditions a sugar plant generally works anywhere between 150 to 200 days per year because of the seasonal nature of the raw material (sugarcane) used by the industry. The stream factor for a sugar plant typically working for about 180 days per year would be just about 50%, on account of external factors alone. Internal constraints of maintenance, breakdowns, cleaning schedules. etc., during the crushing season would lower the stream factor still further.

The internal constraints which affect stream factor adversely are stoppage of plant for maintenance, cleaning, replacement, inspection etc. The overall stream factor is expressed either as a percentage or as number of working days per year, though the latter method or expression is being more frequently used.

Measure of Capacity

Having decided upon the stream factor, the daily capacity of the plant can be determined. Expressing capacity of a plant which produces only a single product is comparatively easier. Some complications arise when the plant has multiple products and product-mix is variable from time to time.

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Product-Mix and the Concept Equivalence

Consider a paper mill meant to produce 50,000 tonnes of paper per annum. It is quite evident that the mill would be producing more than one variety of paper. For instance, one quality of paper might weigh 48 gsm. while other qualities in production programme might include 52, 56, 60, 62, 80, 100, 140 gsm. The same plant and machinery would be employed to produce different quantities of these papers over a period of one year. In such a situation the assessment of capacity becomes slightly tedious.

It is in order to meet such situations that the concept of equivalence proves to be useful. The concept simply expresses the actual output of a particular variety of product for a certain input. It is important that appropriate input (sometimes limiting ones) is chosen. For example, a paper machine might produce x tonnes of 48 gsm paper per machine-day. The same machine would probably produce, approximately, $2x$ tonnes of paper of 140-gsm in the same time. Thus, because of the same input of machine hours, x tonnes of 48 gsm paper and $2x$ tonnes of 140 gsm paper become equivalent. In short, production of different qualities of paper could be reduced to some standard variety which would act as a base. Thus, even if the product-mix were to change from year to year, they could always be reduced to the same standard base and then meaningful comparisons be made. This concept could be suitably extended to plants which manufacture different varieties of product by employing more or less the same plant, equipment, and resources.

Reasonableness of Stream Factor

We have seen that the stream factor has to be chosen with care because it is the key factor on which the size of the plant would be initially determined. The Industry, therefore, has to reckon with the external and internal constraints influencing the stream factor of the particular industry and choose it accordingly. Depending upon the gravity of stoppage and the type of industry, the management devises its own strategy to minimise the down-time of plant and machinery by installation of marginally spare equipment, improvement of maintenance function,

holding ready-to-install assemblies, etc. The industry itself has its own traditions, practices and its own norm of scheduled down-time. Depending upon the modernity and sophistication of the industry group, it has certain range of availability factors which are considered to be reasonable under business like conditions. It is the range and norms of these factors which would guide in the choice of stream factor for the particular industry and which, of necessity, has to be just and reasonable—neither too loose nor too tight.

In many instances, a figure of 330 working days per year is often quoted irrespective of the industry and plant. It is difficult to accept the contention that all the plants—whether a steel plant, a fertiliser plant, a petroleum refinery or a glass factory—have the same stream factor though the industries are quite different from one another. There are many instances where, in spite of best efforts, the industry stream factor has been found to be quite low, especially in cases where highly corrosive and abrasive materials are being processed. It is, therefore, necessary that an appropriate stream factor applicable to the industry and plant in question is chosen and assumed in the calculations at the time of sizing the plant. Thus, there could be plants where the availability factor could be anything ranging from 275 days to 340 days per year.

Capacity Utilisation More Than 100 Percent ?

The question is often asked as to whether capacity utilisation greater than 100% is possible. It should be stated here that if the capacity utilisation is calculated on smaller time horizon such as for a day or a week or a month, it is quite possible that the utilisation could be greater than 100%. This might be due to especialiy favourable conditions of operation existing during the period under review. There might be no scheduled shutdown during that month or period, though it is normally provided for in a yearly figure. The climatic conditions of operation—such as cooling water temperature, humidity etc.,—might be favourable for the process. However, a clear picture appears only for a yearly figure which would have taken into account all the seasonal variations, scheduled shutdowns, cleanings etc. The capacity utilisation figures even for the year could be greater than 100% by bettering on the down-time and stoppages provided for in the basic assumptions. For instance, if the assumptions provided for stream factor of 325 days

and if the management was able to improve on the stream factor say to 330 days (other things remaining equal), the capacity utilisation could be better than 100%. In fact, capacity utilisation figures of 10—15% higher than 100% have been possible through some of the innovations such as, method change, better materials of construction, provision of spare heat exchanger/(s) on a critical duty, process improvements, ready-to-use catalyst basket etc. These improvements/strategies have been used internally by the management to reduce the down-time and improve the stream factors of the plants and in turn the capacity utilisation.

The Unit of Capacity

The unit chosen for capacity is generally such that a physical measurement of the unit is convenient and accurate under industrial operating conditions. It will also depend upon the type of product, i.e., whether it is a solid, liquid or gas, whether it is to be measured in tonnes, kilogrammes, litres, m^3 or simply numbers. For example, capacity of a tractor plant would be stated as 10,000 tractors per year. On the other hand, capacity of a cotton textile mill would be measured in million metres of cloth produced. Several examples of unit of capacity could be mentioned such as : tonnes produced for products like cement, paper, fertilisers, etc., millions of pairs produced for a footwear industry; million cubic metres for gas industry; kilometres of wires produced for cable/wire industry.

On Utilising Capacity

K. Venugopal

Notwithstanding the hefty increases in exports in the last three years—22.1 per cent in 1972-73, 28.6 per cent in 1973-74 and 31 per cent in 1974-75—India was still left with a huge trade deficit of Rs. 1,045 million in the last year. The spurt in exports was more due to the spiralling commodity prices in world markets rather than to increases in the volume of exports. That, prices, particularly of primary commodities, are now showing a downward trend add considerably to the difficulties faced by countries like India which depend on such commodities for the bulk of their export earnings. To neutralise these, the export target for the current year has been revised upwards to Rs. 38,000 million, laying emphasis on increasing the volume of all exports, specifically manufactures.

Larger export of manufactures, if it were not to create shortages for these goods internally, would in the usual run of things mean creating additional manufacturing capacities. But new capacities take time to fructify. Moreover, unlike the past, they now call for far greater investments.

For instance, cement is a commodity, the export of which is proposed to be pushed up from 0.28 million tonnes in 1974-75 to 1 million tonnes in the current year; no doubt, this export would have to keep growing in the coming years. If this can be achieved with the existing capacities, there would be no problem. On the other hand, if new cement factories are to be set up specifically to meet this, it is quite another matter. For, fifteen years ago new cement manufacturing capacities could be established at around Rs. 160 per tonne of annual capacity; but now it takes about Rs. 700 to do the same.

Cement is not an exception. New capacities, in almost any industry one can name, cost far too dear. In the case of developing countries like India where resources are scarce and there are far too many necessities crying out for amelioration, this becomes a serious constraint in creating much needed new capacities.

In this context, the recent news item that the Bokaro Steel Plant has maintained the production of hot metal at 108 per cent of its rated capacity, since early this year till June, is heartening indeed. It is on such 'extras' that can be wrung out of capacities already on ground, that, attention would have to be focussed in the present circumstances. The attempt herein is to cite some instances where such 'extras' seem possible, more by way of illustration than to estimate the totality of such possibilities in the entire industrial sector.

Survey of Existing Literature

A few surveys of the prevailing underutilisation in Indian industries have been made earlier. These have been reviewed by Bergstrom [1]. The point that he makes is that they have all used different yardsticks to measure the capacity of any given unit or industry group.

The National Council of Applied Economic Research did a survey of 129 units and estimated the extent of underutilisation in 14 industry groups during the ten-year period 1955-1964, which was found to vary from year to year. In 1964, it was 10.5 per cent; the least underutilisation was 9.4 per cent in 1962 and the highest 15.2 per cent in 1958. According to Bergstrom, this study has suffered from the use of capacities as defined in the Monthly Statistics of Production published by the Central Statistical Organization, where the number of shifts on which the respective capacities were based have tended to vary even within an industry. Considering this and the qualification underlying NCAER's estimates, that, the number of actual shifts worked have been used in estimating capacity, Bergstorm concludes that the average underutilisation "is considerably higher than the figure given above, but it is difficult to estimate exactly how much higher from the figures given." [1]

He then refers to the study by Lobel and Das of the Indian Statistical Institute in which underutilisation in large scale industries in 1954 was placed at 54 per cent in the manufacture of consumer goods, 34.1 per cent in that of producer's goods and 10.7 per cent in that of semi-manufactures.[1] Capacities are stated to have been calculated on three shifts per day for 300 days in a year and allowance made for maintenance and other unforeseen shutdowns at 10 per cent.

Bose is reported to have calculated capacity on 8,400 hours of operation in a year [1]. On this base, capacity utilisation levels ranging between 23.5 per cent and 50 per cent were estimated in nine manufacturing industry groups in 1962 in the Calcutta Metropolitan District.

Ramaswami and Pfoutz are stated to have concluded, after a study of 38 units covering the manufacture of welding electrodes, tin containers, leaf springs, high tensile nuts and bolts and galvanized pipes and tubes, that, capacities estimated by the Directorate General of Technical Development varied substantially from those provided to them by industry [1]. According to them, while shortage of foreign exchange for the import of components, raw materials and spare parts have undoubtedly limited output, the "demand for the final products is substantially less than full capacity output in the technical sense" [1].

Work sampling techniques, adopted by Solomon to evaluate the utilisation of a group of 35 automatic machines in one plant, are said to have indicated that they remained idle to the extent of 40 per cent of their time for one reason or other. According to Bergstrom, Solomon's overall philosophy towards the question of capacity utilisation is best summarised in his own statement that "there is reason to believe that many Indian plants can increase their output upto 500 per cent with little or no increase in fixed plant" [1]. Solomon is also stated to have discussed various means through which such increases in capacity utilisation could be achieved.

Capacity Utilisation

Engineering Sector : The foregoing underscores the rather large extra capacities available in Indian industry, particularly in the engineering sector. While the approaches to defining capacity have varied in the above studies, what would be more pertinent is to look at the capability of any given equipment or manufacturing stream. Also, the demand constraint observed by Ramaswami and Pfoutz may not apply in the present circumstance when the objective is to increase production for export markets at least cost. There is no doubt whatsoever that the last objective is best achieved by making full use of capacities already on ground.

Compared to engineering industries, continuous process industries are more amenable to capacity measurement. Besides, they produce the intermediates, particularly the metals, so necessary for the former. Any shortfall in their production gives rise to a chain reaction all the way down the line, necessitating costly imports.

Iron and Steel: In this connection, steel immediately comes to mind. Far too often, we have been beset with the problem of shortfalls in production in this strategic commodity. It is, therefore, that the continuing extra-design production of hot metal from the Bokaro blast furnace assumes great importance.

A recent study by the Metallurgical and Engineering Consultants Ltd. (MECON) is reported to have indicated the desirability of using high proportions of sintered pelletised iron ore to improve blast furnace productivity as well as to reduce coke consumption [2]. Bokaro is reported to have achieved a coke rate of 697 kg. per ton of hot metal against the 744 kg. indicated originally in its design specification. The MECON study is reputed to have pointed out that some blast furnaces elsewhere in the world are even now operating on 100 per cent pellet burden with great advantages and that our future steel plants should be planned on a 70-80 per cent sinter burden compared to the 40 per cent or so in the existing plants, Bokaro excepted.

Between sinter and pellets, the latter is preferred. "From the point of view of blast furnace performance, pellets of good quality have proved to be the burden constituent which gives the best possible results for the lowest specific coke rates [3]. "Extensive tests at the Mannesmann steel works at Huckingen indicated that with an 80 per cent pellet burden charge, blast furnace production increased by about 46 per cent, from the 1,400 tonnes a day when the burden consisted of a mixture of sinter and lump ore to 2,040 tonnes a day. As a consequence, Mannesmann decided not to expand their sinter plant, but, to set up a pellet plant for the fine concentrates, pulverized ores and screenings that were then being sintered.

If Mannesmann can change from sinter to pellets why should we also not do the same with our first generation steel plants ? After all, their performance is so often below the mark. The suggestion by MECON to use a 70-80 percent sinter/ pellet burden for the future steel plants

should be extended to the other (existing) steel plants also. In line with the world-wide preference for pellets, additional capacities could be set up for pelletising iron ore for these plants, in addition to catering to the export market, so that, they could operate on a mixed 80 percent sinter plus pellet burden to improve their production performances.

Ferro-Alloy Industry : Another case in point is our ferro alloy-industry which has adopted electric furnace practice, where the thermal energy required to smelt the ore is provided by electricity and, coal (coke) is only used to reduce the ore. So far not one of these plants has harnessed the furnace gas given off during smelting. As could be expected, ferro-alloy production requires large amounts of electricity (Table 1). Elsewhere in the world, electric furnaces are nowadays closed and the furnace gases collected, cleaned and, along with some (additional) coal or coke used to pre-heat and pre-reduce the ore burden in a rotary kiln. The burden is charged immediately in a hot state, into the electric furnace. Such pre-heating and pre-reduction techniques would lead to substantial

Table 1 : Electricity Requirements for Ferro-alloy Manufacture

Ferro-alloy	*Electricity Consumption per ton (in KWH)*
High Carbon Ferro-manganese	3,600 — 4,000
" " Ferro-chrome	5,000
Medium Carbon "	8,000 — 9,000
Low Carbon "	10,000 —12,000
Silico-manganese (75 Mn 20 Si)	6,000
Ferrosilicon (45 Si)	5,500 — 6,000
" " (75 Si)	8,500 —10,000
" " (90 Si)	14,000 —15,000

Nijhawan, B. R. and Bhatnagar, P. P: Scope of Development of Ferro-alloy Industry in India, Symposium on Ferro-alloy Indusfry in India, National Metallurgical Laboratory, Jamshedpur, 1962, p. 134.

reduction in the specific electricity consumption and an equally substantial increase in electric furnace productivity. The adoption of such techniques, it is claimed, has reduced the unit electricity consumption in a Japanese ferro-chrome plant to nearly half the conventional requirement and increased furnace productivity by 100 per cent [4].

The above two illustrations relate to increasing the capabiiity of existing facilities through technical innovations. Coal washing provides another kind of possibility.

Coal Washeries : Till now, only coking coal required by the steel plants is being washed. The general experience in this particular activity has been one of low capacity utilisations and high costs, with limited exceptions. Washery capacities and their capacity utilisations are given in Table 2 for the years 1968 and 1969. After 1969 and until a little more than a year ago, there was considerable difficulty in the transport of coal, as a result of which, washeries did not receive enough coal from the mines; therefore, it would be more appropriate to review their performance when such difficulties did not hamper them.

In accordance with prevalent practice, annual washery capacities have been calculated on an operation of 14 hours per day and 330 days in a year. A comparison of the performance of the different washeries would indicate that it has varied from a low of 35 to 45 per cent in Dugda I to more than 120 percent in the case of Lodna. It would also be seen that there were no significant differences in performance in any washery between the two years.

These washeries may be considered under two heads: as composite washeries and unit washeries. The first type washes a mix of coal from a number of different coal seams or mines. Unit washeries are where the entire coal treated in the washery is derived from one seam or one colliery.

Patherdih, Dugda I, Bhojudih and Durgapur washeries are of the former type and have performed poorly. The reason for this is that the mix of coal supplied to them have often been different from that on which the washeries were designed.

Lodna, Jamadoba and West Bokaro are unit washeries; the Kargali

Table 2 : Performance of Coal Washeries in India 1968 and 1969

Washery	Rated Capacity		Quantity of coal washed (in Million Tonnes)		Capacity utilisation %		Cost of washing[b] per tonne of coal feed
	Per Hour[a] (tonnes)	Per Year (Mill. tonnes)	1968	1969	1968	1969	(in Rs.)
Patherdih	500	2.31	1.275	1.289	55·2	55.8	7.05
West Bokaro	137	0.63	0.462	0.504	73.0	79.6	2.09
Jamadoba	300	1.39	1.415	1.480	102.1	106.8	—
Lodna	70	0.32	4.407	0.399	126.0	123.5	1.85
Kargali	470.4	2.17	2.035	2.374	93.7	109.5	3.90
Dugda I	600	2.77	1.260	0.983	45.4	35.5	6.89
Bhojudih	500	2.31	1.466	1.631	63.5	70.6	6.58
Durgapur	360	1.66	0.691	1.030	41.5	61.8	—

a) Coal Controller and Chairman, Coal Board : Monthly Review of Coal Production and Distribution.

b) Tariff Commission : Cost of Production of Coal and Coke in the Country, July 1967.

washery, though technically a composite one was a captive facility of the National Coal Development Corporation and therefore was more fortunate in the coal it received. As a rule, the unit washeries have performed well.

At this point it would be pertinent to enquire why composite washeries were set up at all. They were set up primarily because most of the coal mines were small and could not meet the entire requirement of a washery. Now that coal mines have been nationalised and the industry is being restructured and rationalised, one would hope such washeries are a thing of the past and only unit washeries would be set up.

Beyond this, the more than rated capacity performances of Jamadoba, Kargali and Lodna washeries deserve attention. There are two possible modes this could have been achieved—one, they worked more than 14 hours a day or alternately more than 330 days in a year; two, they exceeded their hourly-rated capacities.

Both are feasible propositions. To consider the first, the equipment and process flowsheets in coal washeries are no different from those in use in metalliferous ore beneficiation plants, where the usual practice is to rate them on 24 hours of operation per day. Hence, there is no reason why the same kind of equipment cannot give the same performance in coal washeries, provided the requisite coal supply is made available through a well coordinated mining sequence.

The other alternative that a piece of equipment or, a process plant, for that matter, could exceed its hourly or daily rated capacity is not an unreasonable expectation, when,it has been procured on a turn-key basis with a guarantee of a predetermined level. In such cases, the manufacturer often over-designs the equipment in order not to fail to meet the stipulated performance. The built-in extra capacity is naturally included in the price charged by the equipment manufacturer. A discerning enterpreneur would therefore not hesitate to avail of this extra which, after all, is to his benefit.

Cement is another industry where we have been bedevilled with low capacity utilisation in recent years. This industry has slumped from its peak utilisation level of 96.43 per cent in 1963 to 73.3 per cent in 1974 [5] (Table 3). A part of this may be ascribed to the difficult transport situ-

ation as well as to power shortage. Surely, this is not all the story. True, the industry has been persistently making the point that the price fixed by the government for cement does not give it an economic return. Yet, capacity has doubled between 1963 and 1974 (Table 3). If production had kept pace with this expansion in capacity, perhaps there might well have been a glut of cement in the market.

Table 3 : Capacity Utilisation in Cement Industry

(in million tonnes)

Year	*Rated Capacity*	*Production*	*Capacity Utilisation %*
1960	8.71	7.84	90.00
1961	8.87	8.32	93.83
1962	9.25	8.68	93.80
1963	9.51	9.17	96.43
1964	10.43	9.72	93.27
1965	11.04	10.59	95.94
1966	11.69	11.02	94.26
1867	12.28	11.26	91.74
1968	13.86	11.95	86.17
1969	15.33	13.63	88.88
1970	16.76	13.95	83.24
1971	18.29	14.94	81.70
1972	19.00	15.70	83.60
1973	19.21	14.96	77.90
1974	19.45	14.27	73.30

Gurjar, M.N, 1975 : *Commerce* Vol. 131, No. 3349 July 26, 1975, p. 153.

That apart, this is another case where production increases are possible both through minor technical innovations and by making use of the built-in extra capacity. For instance, the use of magnesite refractory bricks in the kiln, instead of the alumina bricks now used, would yield an additional 15 days's production in a year[6]. With alumina bricks, the kiln has to be relined every 3 months or so, whereas with magnesite bricks, which have a life of about II months even according to Indian experience, kiln relining would be limited to once a year. What more, there are two well known magnesite deposits in the country—one near Salem in Tamil

Nadu and the other near Almora in Uttar Pradesh. Our refractory industry is also fairly well developed and the manufacture of such refractory bricks is well within its capability. Other types of basic bricks like forsterite bricks with a similar long life have also been used to line cement kilns elsewhere in the world. According to a recent report, the manufacture of forsterite bricks has also been initiated by one of our refractory manufacturers. Therefore, there should be no dearth of basic bricks to delay the switchover in kiln-lining practice.

As is common with other manufacturing facilities, all our cement plants have been set up with turn-key stipulations. It follows, therefore, that all of them have built in extra capacities. That, this is so, is evident from the fact that most of the Indian cement plants have at times produced more than their rated capacity. A few months ago, it was reported that some of them had done so even last year. At the same time, rarely have they done so on a sustained basis, over a period of years.

An analysis of literature on productivity in this industry brings to light some curious features. For example, a report of the productivity study group of the National Productivity Council [7] concluded that "Cement machineries which are 10 to 15 years old, generally, produce much below the rated output. A programme of rehabilitation of such machinery should be pushed through as quickly as possible with Government assistance so that productivity of those units may increase." Earlier on, the report provides a statement of the units requiring rehabilitation which includes units like Banmore, Bhupendra, Dwarka, Khalari and Shahabad, among others. In the case of the last it says: "Kiln No. 2 and 3 installed in 1925 and 1929 respectively are to be renovated." Yet production trends (given in the same report) over the period 1950 to 1951, of the above-mentioned plants tells quite a different story (Table 4).

Sometimes international comparisons are made to show how well our industries perform. For example, in 1960, our cement capacity stood at 8.71 million tonnes, production was 7.84 million tonnes giving a capacity utilisation of 90 per cent. In the same year, production in the U. S. was 40 million tonnes from a total capacity of 50 million tonnes; capacity utilisation was only 80 per cent [8]. And conclusions may be drawn that we have performed better. However, it should not be forgotten, that, in a competitive economy, capacity often tends to exceed demand. If we delve deeper, the following fact emerges. While they may not pro-

Table 4 : Capacity Utilisation in Some Cement Plants 1956-1961

Plant	*1956*	*1957*	*1958*	*1959*	*1960*	*1961*
Banmore	102.7	107.1	108.6	97.2	103.8	103.3
Bhupendra	82.8	93.6	96.0	95.8	101.6	115.9
Dwaraka	102.1	100.8	119.5	119.1	117.1	114.1
Khalari	95.3	110.0	96.7	103.0	125.0	95.8
Lakheri	106.2	97.7	101.7	94.6	92.1	100.9
Shahabad	95	101	111	112	105	85

Rehabilitation Required

Banmore	— (i) Raw Mill (ii) Boiler Plants (iii) Renovation of Chain Conveyors
Bhupendra	— (i) Crane Motors (li) 4 Shovels (iii) 6 Dumpers (iv) 3 Kiln shells (v) 2 Mills (Shells and end bottoms) (vi) One Mill Motor (vii) One loco (viii) One Scraper Hauler
Dwaraka	— (i) Renovation of 3 cement mills (ii) Renovation of 5 raw mills
Khalari	— (i) Raw Mill (ii) 2 Locos (iii) 4 Compressors (iv) kiln live rings and two rollers.
Lakheri	— (i) Coal handling plant for kiln coal (ii) One packing machine (iii) Mix Basin (iv) 1 Bull Dozer (v) Coal handling and grinding plant for boilers (vi) Installation of Std. H. P. fan for kiln No. 3 (vii) Fluidification of Cement Silos,
Shahabad	— (i) Kilns Nos. 2 and 3 installed in 1925 and 1929 respectively are to be renovated

Source : National Productivity Council (1964) : Cement Industry, Report of Productivity Study Group, pp. 13 and 14.

duce cement to their capacity, they do not let their equipment lie idle[9] : "when demand for cement was weak, some cement plants turned to the manufacture or processing of other materials for which they were equipped and favourably located to handle. These included crushed (lime) stone for agricultural use, road metal or flux; fertlizers; and the custom crushing of other minerals or materials. Idle kilns were converted to the production of lime and occasionally to various other uses such as sintering clays and shales to obtain light weight aggregates; nodulization or agglomeration of iron ore for open hearth and blast furnaces; production of sponge iron; calcination of petroleum coke, dolomite and limestone; drying and calcining bauxite, manganese ore and phosphate." The search for opportunities to utilise equipment to the utmost and the readiness to adapt and change indicated above are certainly worth emulating.

This may bring a rejoinder that conditions in India are very different and that, often we are unable to meet the demand fully. This is not always true. For example, we have one small 'low shaft, pig iron plant in Orissa. Admittedly, such a plant cannot compete with large scale plants. Therefore, this small plant has had a chequered history. In times of shortage, the (high cost) plant is able to sell its pig iron without difficulty. At other times, it is helpless against the giants. Could not this plant, for instance, have produced ferro-manganese instead of iron, whenever demand for the latter was low ? Not that ferro-manganese cannot be produced in such furnaces. It can be, provided, coke from low phosphorus bearing coal is available. And such coals are available, though they are not of the metallurgical variety. Soft coke can be made from such coals which could be used in low shaft furnaces. The opportunity was there, but, only, it was not snapped up.

Similarly, a few years ago, the ferro-alloy industry went through a similar bleak phase arising from lack of demand, internally. Export opportunities were blocked because of the high production costs. As can be expected, inventories piled up. All this, at a time when there was a spurt in the demand for pig iron. The industry could have easily switched to making iron instead of ferro alloy and made profits.

Currently, there are a large number electric furnace steel plants suffering from lack of demand. Their position now is no different from that of the low shaft pig iron plant or the ferro-alloy industry some time back. But, then, these small electric furnaces are ideally suited for the manufacture of alloy and special steels, particulary, for the varieties which are needed in small quantities, which, the larger alloy steel plants may not find worthwhile to make. Of course, this requires special efforts to identify specific needs and, thereafter, adapt to meet them.

How to Use Existing Capacity Effectively

The foregoing indicates that there are three ways by which existing manufacturing facilities could be put to greater use. They are : one, through technical innovations; two, through changes in the product mix; and, three, through utilising the 'extras' provided in the design, on account of performance stipulations laid down when the equipment was ordered. Of these, the last is the one that can be availed of straight away. The question then arises: what is the extent of the extra capacity so availa-

ble ? It must be admitted in this context, while most of our process plants have been installed on a turn-key basis and would, therefore, have built in 'extras', the exact quantum of over-design would vary from plant to plant.

In the cement industry, for instance, it may be a little in excess of 20 per cent, if one were to go by some recent production trends.* Though in one case, it is understood that a kiln originally rated at 200 tonnes a day was subsequently re-rated to 265 tonnes a day; in other words, the effective capability was 32.5 per cent higher than its original nameplate rating.

The Lodna coal washery has performed at 26 per cent above rated capacity. There is no reason why the other coal washeries cannot do so, if only they are provided with the requisite coal, in terms of quantities as well as the quality mix for which they were designed. It may even be possible to raise their extra capability further to around 30 per cent or so. Some years ago, a paper plant manufacturers advertised that one of the paper plants it had set up in India had attained a production level 35 per cent above its rated capacity.

Yet another example is the Burmah-Shell petroleum refinery at Bombay. This refinery was originally licensed for a crude throughput of 1.5 million tonnes a year. However, as first installed its capacity was 2.3 million tonnes a year[10]. Subseqently, this refinery was permitted to be expanded; now its capability is stated to be 5.2 million tonnes [10] against an approved capacity of 3.75 million tonnes. In other words, the extra capability of this facility has always been around 50 per cent.

It is not only in the private sector refineries, that such bonuses are available. Public sector refineries, too had similar built-in extra capabilities. Thus, the capability of the Koyali refinery has been raised from the original throughput of 3 million tonnes a year to 4.3 million tonnes through a process of revamping and debottlenecking (minor modifications of specific sections of the refinery).

*Banmore cement factory produced 119.9 and 121.3 percent of rated capacity in 1967, 1968 and 1969 The Chittorgarh cement produced 122.7 and 117 3 percent of rated capacity in 1969 and 1970.Dalmia (Bharat) plant achieved 122 4 percent of capacity in 1967. The Sankaridrug plant attained 121.1 percent of capacity in 1965.

It is apparent, therefore, that extra built-in capacities in process plants may vary from a little over the name-plate rating to as much as 50 per cent. The actual quantum of this average would have to be determined individually for each plant. In some cases, minor modifications by way of balancing equipment would be needed. However, the investment on these would be far less than what would be required for altogether new plants.

It is true, the attempt herein has been confined to illustrating a few possibilities by way of securing extra capabilities from manufacturing facilities already on ground. But there is no doubt whatsoever, that the existence of such possibilities is far more widespread in Indian industry than the few illustrations cited. Therefore, in the face of the resource limitations facing India at the present and the export opportunities that have come our way since the advent of the so-called oil crisis, it behoves on every entrepreneur to explore the possibilities of stretching the capability of his plant to the fullest extent.

REFERENCES

[1] Bergstrom, Gary. L. : "Resource Utilisation in Indian Manufacturing—A Mathematical Analysis", Progressive Corporation Private Ltd., Bombay, pp. 7—11,

[2] ,, : "Iron Ore Utilisation—MECON Study is for Pelletisation" *Commerce*, Vol. 131, No. 3349, July 26, 1975, pp. 163 and 164.

[3] United Nations : Economic Aspects of Iron-Ore Preparation", Secretariat of the European Economic Commission, 1966, pp. 64 and 65.

[4] Yasu hisa Kanoh : "Solid State Reduction of Chrome Ores". Ferro-alloys : *Special Issue Metal Bulletin*, 1971, pp. 83

[5] Gurjar, M. N. : "Cement: On to better Capacity Utilisation", *Commerce*, Vol. 131, No 3349, July, 1975, pp. 151—153.

[6] National Council of Applied Economic Research : Report on Cost Price Structure of Cement, 1963 (unpublished 5.47—5.49.

[7] National Productivity Council : Cement Industry, Report of the Productivity Study, Group 1964, p. 44

[8] Mehta, P. K. : "The American way—Special Study, *Cement, Quarterly Journal of the Cement Manufacturers' Association*, Vol. 1, No. 1, October 1967, pp 15 and 16.

[9] U.S. Bureau of Mines : "Mineral Facts and Problems," 1956, *Bulletin* No. 585, 1960 edition pp. 169,

[10] Das Gupta, B : "The Oil Industry in India—Some Economic Aspects", 1977, Frank Cass & Co. Ltd. London, pp 136 and 141.

Industrial Capacity : A Concept

B. Hari

There are few words capable of covering more meaning than capacity. The deceptively simple term "capacity" has been much discussed, too frequently misunderstood and conjures up different images to different people both in the industry and outside the industry. The two extreme expressions of this misunderstanding are "our production this year has reached 130 percent of our capacity" and "production in unit X is only 20 percent of its capacity". So far as the first statement is concerned it must be said that it is prima facie wrong, as under no circumstances, production can be greater than capacity. The "over achievement", as a matter of fact, may be due to one or all or any combination of the following factors :

(i) In case the capacity is expressed in terms of value of production a price rise may inflate the utilisation figure;

(ii) In case the industry is a labour-intensive one, employment of additional labour or a high doze of overtime would increase the production;

(iii) Production can further be increased by letting out certain items of production to sub-contractors.

In either case, however, it cannot be said that production is more than the capacity, for the obvious reason that capacity and its utilisation is not independent of other inputs that go in production. Once the inputs are increased, the capacity is automatically pushed up. But for the purposes of capacity utilisation, it has become more expedient and convenient to treat that production figure which is termed as capacity static with no reference to increased inputs.

Further, there are certain other subtle factors that may affect both production and capacity of a unit. For example, in mining industry, if by sheer good luck the metal content is more than what was anticipated at the time of rating the capacity, the production will be more than the

capacity if corresponding increase is not made (which of course should be made) in the capacity. The reverse would be the case if the metal content has gone down in subsequent years. Then, there are factors like the inbuilt safety margin and the surplus capacities of the non-critical machines, change in product mix, etc.

It must, therefore, be recognised that capacity, instead of rigid and static concept, is a flexible and dynamic concept calling for periodic revision upward or downward—depending upon the changed factors of production.

In any case, at a given point of time, the best approach is to start with the maximum capacity and then work back to achieve at the rated capacity in the light of various constraints. The easiest way to do it is to identify the real causes that may prevent the achievement of the maximum capacity. This would, however, call for greater ingenuity and resourcefulness on the part of capacity analyst in making a judicious difference between the real causes and more apprehensions. Following are some of the common factors that are often advanced for down-rating the capacity :

a) Power cut during last year is an 'EXCUSE' for down rating the capacity for the current year;

b) Expected reduction of ilmenite content (a material recovered from beach sand by separation process) in raw sand is a 'FEAR' unless proved otherwise by means of past data;

c) Worker efficiency being low is a management 'EXCUSE' invented to hide lack of proper training and motivational efforts and not to be considered for rated capacity except in case of an infant unit which is yet to stabilise.

d) The contention that 'Design capacity as given by collaborators' or project report is wrong, as last ten year's average production is much lower, is an 'EXCUSE' in disguise and is usually given due to following reasons:

   — Confusing average production with rated capacity;

   — Inability to locate the factors/reasons which have reduced the designed throughput rate.

e) 'Higher breakdown time is due to the complexity of machinery, is mostly an 'OPINION' emphasized to cover up inadequate maintenance efforts.

These examples are not exhaustive, but to illustrate the point that a capacity analyst needs to investigate before accepting any factor. By arriving at the causes and factors affecting capacity, for better comprehension group them under the three heads, viz., Unavoidable, Semi-avoidable and Avoidable.

Unavoidable causes as compared to avoidable causes would be mostly permanent in nature; for example, an industry working only one shift, wherein two shifts per day is a permanent loss. Of course, concept of permanency involves considering the time span. A question might arise as to what time span to choose. One factor which should be considered for this purpose, is capacity monitoring time interval. For example, if capacity is monitored annually, any factor affecting capacity which is expected to be there for at least two or three years could be considered permanent. However, this should be treated only as a guide. The actual decision would vary from industry to industry. Appendix 1 gives some causes affecting capacity thus grouped.

Rated Capacity

To arrive at the rated capacity consider unavoidable and semi-avoidable causes only. In case of unavoidable causes subtract the capacity loss fully from the maximum capacity. In case of semi-avoidable causes set a standard which is considered under the circumstances as normal or as unavoidable. Subtract the capacity loss corresponding to this standard, further form the maximum capacity. What is obtained is rated capacity.

Example 1 :

Maximum capacity	:	12,000 Units per year
Loss due to unavoidable causes		10%

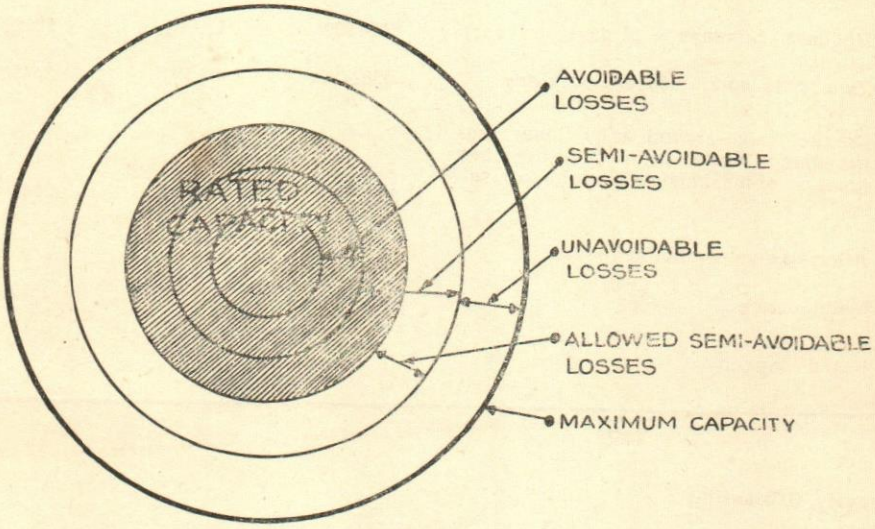
Loss due to semi-avoidable causes 9%

Standard for semi-avoidable causes 5%

$$\text{Rated capacity} = \frac{(100-10-5)}{100} \times 12{,}000$$

$$= 10{,}200 \text{ Units per year}$$

The diagram below would clarify the point mentioned above :



Denominator for Capacity Utilisation

Once maximum capacity and rated capacity are computed, the question arises as to which one to use for capacity utilisation. Convincing arguments could be given for both. However, the author would recommend using maximum capacity and giving both attained production as well as 'Rated Capacity' as a percentage of this, because maximum capacity is static and does not change unless there is a change in the input resources. Rated capacity, however, would change under the following conditions:

(a) Change in standard for semi-avoidable losses or allowed percantage for semi-avoidable losses;

(b) Unavoidable losses becoming semi-avoidable or avoidable due to changes in management policy, improved technology, etc.

Example 2 : **An Engineering Industry Producing Different Products**

		Capacity present (*Machine hours*)	*Capacity loss*	*Capacity available* (*Machine hours*)
1.	Maximum capacity	6694392	—	6694392
2.	Unavoidable losses			
2.1	Holidays (Sundays @ 65 days per year)	6694392	17.8%	5502790
2.2	Two shifts working @15½ hours/day	5502790	35.5%	3549300
2.3	Product mix—arrived at by linear programming model with the objective function of maximising capacity utilisation	3549300	25.5%	2644229
3.	Allowed semi-avoidable losses			
3.1	Maintenance	2644229	5%	2512018
4.	Rated Capacity			

Capacity Utilisation

	Machine Hours (in '000)	*Percentage*
Maximum capacity	6694.4	100.00
Rated capacity	2512.0	33.53
Attained capacity	1620.3	24.20

By way of conclusion, it must be said that the exercise of capacity utilisation is a management tool to ensure the optimum utilisation of all the resources and hence should be done in a most objective manner. It should neither become a camouflage for inefficiency nor a stick to beat the production personnel.

APPENDIX I

Grouping of Causes Affecting Capacity

	Description	*Unavoidable*	*Semi-avoidable*	*Avoidable*
1.	Single shift working	*		
2.	Coffee break/lunch break	*	*	
3.	Absenteeism		*	
4.	No Operator			*
5.	Product Mix	*		
6.	Breakdown		*	
7.	Scheduled maintenance		*	
8.	Process shutdown		*	
9.	Inspection time		*	
10.	Production lost due to destructive testing	*		
11.	Poor quality of raw material		*	*
12.	Process shutdown		*	
13.	Power failures	*	*	

Note : Wherever * appears in more than one column, it means the grouping would depend on the local conditions.

Capactiy Utilisation in Indian Industries : A Review of Existing Literature

P.V. Rao Akhilesh Kumar

The problem of underutilisation of industrial capacity in India came into focus during the Second Plan period when large scale investment programme for industrial expansion was initiated. However, it was towards the end of the Third Plan that the problem was subjected to extensive analysis.

In the past, a number of studies have been conducted to assess the capacity utilised in Indian industry. These studies concentrated mainly on two aspects of the problem, (i) estimates of underutilisation of capacity in different industries; and (ii) factors affecting the utilisation level. In the process some studies have also dealt with other aspects like defining the concept of capacity, effects of underutilisation of capacity, policy measures required to improve capacity utilisation, etc.

The purpose of the present paper is to highlight the salient features of the various research studies conducted in this field and in the process pinpoint some less explored areas of research.

Concept of Capacity

While discussing possible meanings of capacity, Lobel has noted that "the first requisite is that objectives and conditions be specified for each study" [13]. Morris Budin and Samual Paul [4] have observed that "in its broader sense, the capacity refers to the potential output per unit of time that a plant can yield under given processes and conditions." This definition used by the Government of India also though not rigorous enough, is the basis of all the studies which deal with this problem at a macro level [4, 7, 8, 9, 10, 11, 12]. The figures given in Monthly Statistics of Industrial Capacity and Production are based on single shift operation, unless otherwise specified. However, while calculating the potential capacity [4, 8, 11] assumptions regarding multiple shift pattern have been made.

The other definition of maximum capacity used by micro level studies

[5, 6, 13] computes total capacity on the basis of "total amount of productive time available per year on capital equipment." The more optimistic assumption of Bose [6] is that fixed capital may be utilised 24 hours a day, 350 days a year, or 8,400 hours per year. The Bergstrom study [13], estimates the maximum capacity of a manufacturing facility, using linear programming technique because, he feels, "capacities must be defined with reference to product lines and technical characteristics, as well as inter-relationships among various machine groups".

Estimates of Capacity Utilisation

The earliest reports [1] which studied the problem of unutilised capacity in Indian industries covered about 80 industries over a period of eight years (1946-53) estimated that about 50 per cent of the capacity of Indian industries remained unutilised. The study by Lobel and Das [3] calculated total capacity on the basis of three shifts per day for 300 days a year. This figure was then reduced by 10 per cent to allow for maintenance and other enforced idle time. The survey covered large scale industries only during 1954 and estimated utilisation ratios at 54, 34 and 10·7 per cent respectively for consumer goods, producers goods and semi-manufacturer's industries. Morris Budin and Samuel Paul [4] undertook to study the trend in utilisation of Indian industrial capacity. They covered about 75 industries for which Monthly Statistics of Industrial Production provided the data. For this purpose they prepared an index of average utilisation of capacity[1] covering the period 1951-59. The study revealed that the average utilisation of capacity was as high as 90 per cent in Indian industries and the same has been going up from 75 per cent in 1951 to 92 per cent in 1959. This study also estimated utilisation of potential capacity which was defined as the "capacity for two shifts operations of all firms previously reporting on a one-shift basis and two or three shifts for all other firms."

During the sixties, when Indian economy, especially the industrial sector, started showing the signs of fissure the problem of underutilisation of

1. $I_{ac} = \frac{\Sigma(O'_n W')}{\Sigma(C_n W')} \times 100$

Where O'n is the average monthly output of the i-th item in the n-th year. C'n is the average monthly installed capacity as reported for the i-th item in the n-th year. W' is the value added weight for the i-th item.

capacity also became acute. At macro level, one of the most ambitious reports on capacity utilisation was released by the National Council of Applied Economic Research [8]. Information was collected through a questionnaire mailed to 4,728 manufacturing units in 17 industrial groups covering 276 industries. Replies of 129 of these firms were tabulated in their final report. The methodology adopted was similar to that of Morris Budin and Samuel Paul. The study concluded that the overall index of underutilisation of 14 industry groups in 1964 was 10.5 per cent, with considerable fluctuations from year to year. For the ten-year period studied (1955-64) the greatest amount of underutilisation occurred in 1958 (15.2 per cent) and the least in 1962 (9. 4 per cent). Leaving aside the question of bias due to small sample size, these figures are heavily qualified also, since they are based on only actual shifts worked. The RBI study [11] examined the problem in three groups : chemical industries, metal and engineering industries and others. The potential output is calculated on the same formula with an assumption that the required quantities of raw materials, power, transport facilities and skilled manpower will not pose any problem. The survey coverd 163 industries out of which 72 lie in chemicals, 78 in metal and engineering and the remaining 13 in others. The study revealed that underutilisation of capacity in industries increased from 17·7 per cent in 1963 to 21·4 percent in 1967. The rise was 29·5 to 32·0 per cent in chemicals 12.7 to 23.2 per cent in metal and engineering and from 18·1 to 19·4 per cent in other industries. An interesting conclusion of this study was that if the capacity output is achieved, industrial production can increase at the rate of 10—13 per cent per annum, over the next 4-5 years period. The estimates of underutilisation during 1967-68 as estimated by Raghunath K. Koti [9, 10] also fall near these estimates. Recently, an IDBI Report has estimated that the underutilisation ratio has shot up from 22 per cent in 1968-69 to 30% in 1973-75.

The studies by Solomon [5], Bose [6] and Bergstrom [13] have estimated the extent of underutilisation in some selected industrial units. As the studies use the concept of maximum capacity, their estimates are somewhat higher than others. Bose uses the reciprocal of percentage utilisation of capital equipment named as "multiplier for full capacity utilisation." This multiplier is an adjustment factor between the value of production in the time actually worked and the value of production based upon 8,400 hours of operations per year. It ranges from 2.0 to 4.26 for various industries in the Calcutta

Metropolitan District. The estimates are based on some assumptions such as standard product-mix, constant productivity of labour and a proportionate amount of time necessary for set up and maintenance etc. The range of utilization rates during 1962 is 23.5 to 50 per cent in 9 manufacturing industry groups. Solomon uses the work sampling techniques for the determination of individual machine utilization and remarks "that many Indian plants can increase their output by 50% with little or no increase of investment in fixed plant." Bergstrom report which has used the linear programming technique for estimating the maximum capacity of two large scale Indian manufacturing companies namely, Hindustan Electronics (HE) and Transport Engineering Company (TEC), estimates that actual physical production over the three year period ranged from 37 to 54 per cent in the case of the former. In the case of latter, the linear programming model shows great variance in equipment utilisation between various machine centres. While some centres are scheduled at 100 per cent capacity, others are not utilised at all.

From this review it is observed that though different studies give different estimates of underutilisation in Indian industries, there is a substantial scope for an improvement in the resource utilisation in many units. These studies also bring out the inter-industry differences in capacity utilisation.

Explanation for the Underutilisation

Most of the studies [1, 4, 8, 11] mentioned above have studied the factors affecting the capacity utilisation (or underutilisation) such as power shortage, transport bottlenecks, industrial unrest, shortage of vital inputs like coal and steel, lack of demand, market structure etc. Therefore, It would be pertinent at this stage to mention two studies conducted by Raghunath K. Koti [9,10]. He adopted a two-stage capacity estimation method, covering all the industries (including mining but excluding textile and food industries) making 21 broad groups of industries. In the first stage, the product-wise figures on percentage underutilisation of capacity are weighted by the corresponding figures on the estimated value of capacity. In the second stage, the figures for all industries are aggregated. The author canvassed a questionnaire with 234 companies to analyse the reasons for underutilisation of capacity. Out of the total, 200 companies reported underutilisation. Among the various reasons, lack of demand (56) and

shortage of raw materials and components (55) stand out prominent. Other companies reported either some other reason or a combination of these.

Samuel Paul[2] has also addressed himself to this aspect of the problem while studying the inter-industrial differences in capacity utilisation. He divides all the factors that can explain underutilisation in any industry at any point of time into three groups :

(a) *Industries Characteristics* : (i) Market structure, (ii) Pressure of demand and (iii) Size of the firm,

(b) *Policy Influences* : (i) Import substitution, (ii) Effective Rate of Protection (ERP) and (iii) Raw materials allocation;

(c) *Outliers* : (i) Major additions to capacity in the preceding year, (ii) Strikes, (iii) Power shortages and (iv) Transport bottlenecks.

The first attempt was made to test the hypothesis that utilisation rates are a function of six variables (a and b groups), then the entire industries group was divided into two categories : (i) Capital and intermediate goods and (ii) consumer goods and proceeded to estimate equations separately for each. For the first group, *Industry Characteristics* alone explained 40 per cent of the inter industry variations in utilisation rates. When the policy variables (b) above were introduced, nearly 72 per cent of variance was explained. The results obtained for the second group with some independent variables yielded discouraging results. An important finding of this study is that high levels of effective protection have adversely effected the rate of capacity utilisation.

Some of the above studies have ventured into some other aspects of the problem also. Morris Budin and Samuel Paul have elucidated the significance of maxinmum utilisation of capacity especially for a developing economy. In this regard, they observe that "it (better utilisation) has the effect of lowering the incremental capital-labour ratio and the incremental capital output ratio". The volume taken out by the Federation of Indian Chambers of Commerce and Industry [12] discusses the problem of capacity utilisation and productivity in different sectors of industry. It also suggests measures to achieve better utilisation of installed capacities.

2. Growth and Utilisation of Industrial Capacity, Samuel Paul, *Economic & Political Weekly* Vol. IX No. 49, Dec. 1974, pp. 2025-2032.

Less-Explored Areas

From the above discussion it becomes clear that the problem of under-utilisation of capacity, which is constantly arising during the past fifteen years or so, has not been studied intensively. No doubt, the estimates of underutilisation give an idea of the magnitude of the problem, but more in-depth analysis of the factors should be undertaken. The micro-level studies of the worst affected industries should be undertaken using the Bergstrom technique. The impact of market structure on capacity utilisation should also be studied in detail because of its policy implications. It has been observed that high effective protection tends to keep alive inefficient industries incapable of utilising their capacity effectively. This aspect needs further enquiry. Some of the other areas which need more research are :

(a) Cost-Benefit analysis and financial viability of full utilisation of manufacturing capacity;

(b) Underutilisation of capacity in other sectors of the economy specifically, agriculture, irrigation, power, and transport; and

(c) Manpower planning and capacity utilisation.

REFERENCES

[1] Vakil, CN — Indian Industry's Installed Capacity and Present Production Levels, published in papers relating to the formulation of Second Five-Year Plan, Planning Commission, 1955.

[2] Planning Commission, Govt. of India. — Economic Division, Planning Commission, Installed Capacity and its Utilisation in Indian Industries, published in papers relating to the formulation of Second Five Year Plan, 1955.

[3] Lobel, E & Das — Unpublished Report, Indian Statistical Institute, Calcutta, 1955.

[4] Morris Budin & Samuel Paul — The Utilisation of Indian Industrial Capacity 1949-1959, *Indian Economic Journal*, Vol IX, No. 1, July 1961.

[5] Solomon, MJ — Better Plant Utilisation in India—A Blue Print for Action, New York, Asia Publishing House, 1963.

[6] Bose, AN — Implications of Capacity Utilisation—A Study of the Calcutta Metropolitan District, Calcutta, Sree Saraswati Press Ltd., 1965.

[7] Ramaswami, VK & Pfoutz, GD — Utilisation of Industrial Capacity, Unpublished paper, Government of India, U.S. Agency for International Development, New Delhi, Dec,, 1965.

[8] NCAER — National Council of Applied Economic Research, Underutilisation of Industrial Capacity, New Delhi, 1966.

[9] Raghunath K. Koti — Capacity Utilisation and Factors Affecting it in Certain Indian Industries, 1966-67. Mimeograph No. 2, Gokhale Institute of Politics & Economics, Poona, 1967.

[10] " — Utilisation of Industrial Capacity in India, 167-68, Gokhale Institute of Politics and Economics, Poona, 1968.

[11] RBI — Reserve Bank of India, The Index of Potential Production, prepared by V.V. Divatia and Ravi Varma in the Department of Statistics, *R. B. I. Bulletin*, April, 1970, Bombay.

[12] FICCI — Federation of Indian Chambers of Commerce & Industry (FICCI), Seminar on Maximization of Capacity Utilisation and Productivity held in August 30-31, 1971, in New Delhi.

[13] Bergstrom, (Dr.) GL — Resource Utilisation in Indian Manufacturing : A Mathematical Aanlysis, Progressive Corporatoin Pvt. Ltd., Bombay, 1973.

Capacity Utilisation in Public Sector Enterprises; Problems and Prospects

Bazle Karim **B. T. Bhide**

In the total picture of the Central Government Public Sector Industrial and Commercial Enterprises, the production sector (enterprises engaged in the manufacture of goods) occupies a very significant position. Nearly 80% of the investment of the exchequer has gone into this sector. These enterprises cover a wide range of manufacturing activity, much of which is the core of the nation's industry. Their products range from steel, minerals and metals on the one hand, to sophisticated electronic and communication equipment on the other; covering in this spectrum, industrial products such as petroleum and petroleum products, basic organic and inorganic chemicals, transportation equipments, earth-moving equipments, railway rolling stock and ships, light, medium and heavy engineering equipments including structurals and structural fabrications, machine tools, photo films, paper, consumer goods like bread, and many other commodities.

The number of production enterprises under the control of the Central Public Sector is increasing year after year. Many of these are the product of unmixed State enterprises, while some others had to be taken over by the State in the larger interest of the economy on account of various social, political and economic reasons. The present number of such production enterprises is about 70 and they have more than 120 units. Some of these units are in the construction stage, some are in the initial stages of production, while some have established their production lines for quite some time now and are well set in the production process.

Capacity Utilisation: An Important Performance Index

Capacity utilisation is an important indicator of efficient running of these enterprises. Situated as they are in the public sector, of vital significancse to the national economy is their operation. As the very philosophy of the public sector derives from two fundamental considerations, namely, the creation of a sound industrial infrastructure and the stimulation of balanced regional development, utilisation of installed capacities in the

capacity. It may not be out of place to mention here that the Bureau of Public Enterprises is currently engaged in studying such cases and in arriving at a workable definition of rated capacity in respect of such enterprises over a reasonable time horizon. This project has the consultancy support of the National Productivity Council, New Delhi.

(b) Incorrect Choice of Technology : Experience shows that this is by far the largest single reason which leads to perpetual problems of underutilisation of capacity. There are instances where newly developed technology which was still to be conclusively proven elsewhere in the world was purchased by this country without careful analysis with reference to the working environment, the quality and quantity of available raw materials, the level of skills and other technical support to sustain the plant, etc. Under these circumstances, the plants enter problem areas which are very very difficult to resolve subsequently. An examination of enterprises which have yet to cross a respectable level of capacity utilisation in the public sector would reveal that many of them suffer the scars of incorrect choice of technology. The experience gained in the past 25 years, has enabled the Government and the public sector to place considerable emphasis on a thorough examination of the technology of the plant.

(c) Inadequacy of Demand : Planned development is dependent not only on certain assumptions, but more importantly on their realisation. Planned development is also conditioned by capital scarcity. Under these circumstances, there are certain Public Sector Enterprises/Units which suffered from lack of demand for their product on account of non-availability of capital for investment into projects for which these plants were supposed to supply the materials and equipment. Non-availability of funds for going ahead with the programme of steel plant construction has resulted in lack of demand for the Heavy Engineering Corporation which was set up to undertake the manufacture of equipments required by steel plants. There are certain cases in the public sector enterprises where inadequancy of demand arising out of such factors has resulted in underutilisation of capacities. In order to counter these tendencies, efforts are being made by the Government and the Public Sector Enterprises to diversify, to the extent possible, into other production lines.

(d) Inadequacy of Raw Materials : Inadequacy of raw materials may arise on account of natural shortage of raw materials in the country or, alternatively, the inability of feeder industries to supply raw materials in

adequate quantities. Inability of the mines to supply lignite in sufficient quantities for power generation and urea production is a case in point. The underutilisation of capacities in the thermal power station and the urea plant of Neyveli Lignite Corporation is traceable to the inability of the mines to supply the required quantity of lignite. This inability of the mines is further traceable to inadequacies of technology in our environment. It may, however, be said that, by and large, Public Sector Enterprises have ever since overcome inadequacy of raw materials.

(e) Inadequacy of Power : The general power famine in the country has seriously hampered the performance of Public Sector Enterprises. Even though many Public Sector Enterprises do get a priority treatment as regards power allocation from the States on account of the vital nature of their products, there are examples where underutilisation of capacities is traceable to power shortage. The Nangal unit of Fertilizer Corporation is a case in point.

(f) Lack of Balancing Equipment : There are certain Public Sector Enterprises where lack of balancing equipment has led to underutilisation of capacities. Such cases are being studied and are being rectified.

(g) Industrial Unrest : Certain units have suffered in the past perpetually on account of industrial unrest, leading to underutilisation of capacities. Such units are the Hindustan Steel Ltd., Durgapur Steel Plant.

(h) Managerial Shortcomings : Of utmost importance, however, is underutilisation attributable to managerial shortcomings and this is an area where there can be absolutely no excuse on the part of the public sector enterprises for capacity underutilisation. The public sector enterprises are indeed faced with a formidable managerial gap on account of the fact that adequate number of managerial personnel are just not available even today in the country to man the enormous investments in the public sector. The Government and the public sector enterprises have, however, been making constant efforts to improve the various facets of operational management in order to overcome underutilisation of capacities on that account. In this connection, emphasis is being laid on proper structuring of organisations, better maintenance of equipment to avoid downtime leading to underutilisation of capacities, better production planning and control systems, better inventory management, better management of available resources through the use of

sector enterprise/unit. It is recognised that, for a commercial and business operation, profitability, returns on investment, and build up of reserves are equally important criteria. The fact remains, however, that in the context of the needs of the national economy, capacity utilisation in manufacturing public sector enterprises is a very important efficiency indicator, much as the body temperature is a significant indicator of the health of a normal person. We view capacity utilisation from this point of view and the public sector enterprises at large are quite conscious of the fact that many a managerial improvement would follow in the wake of recognising the paramount importance of the need to utilise fully the installed capacity.

modern Industrial engineering/productivity techniques and better motivation of men through well designed incentive schemes. The public sector enterprises are also laying greater and greater emphasis on long range and corporate planning activity integrated with organisational and management development plans.

The Present Status and the Prospects

Concerted attention from the various governmental levels and from the individual public sector managements have, in the recent past, resulted in the picture of capacity utilisation becoming brighter and brighter for the manufacturing public sector. In fact, there are enterprises/units which have reached the level of full utilisation and have maintained it. Many have reached the level of 75% utilisation. The following table gives a picture of capacity utilisation percentages by cognate groups among the public sector. It gives comparative figures for the years 1972-73 and 1973-74.

Capacity Utilisation and Profitability : A Case Study of Fertiliser Units

Meena Gupta M.J.K. Thavaraj

Underutilisation of capacity is widespread in mature capitalist economies. Deficiency of demand is generally responsible for such underutilisation of the stock of productive capital. Often, monopolistic and oligopolistic practices are associated with maximisation of gains through restricted output. These tendencies are sometimes condoned as wastages of affluent societies. By the same token, underutilisation of capacity is a luxury which developing countries can ill-afford. In India, big business houses have always indulged in antisocial practices like pre-emption of capacities and monopolistic and restrictive practices. Inter-sectoral imbalances in the implementation of programmes and shortages of various kinds have also contributed considerably to underutilisation of capacity in crucial sectors of the Indian economy. Unutilised capacity has meant higher cost and lower profitability. A case study of a fertiliser unit is meant to show the scope for cost reduction and increase in profitability arising from fuller utilisation of attainable capacity.

Concept

Productive capacity is the maximum output which the current stock of plant and machinery is capable of producing during a period of time. However, there are many ways of interpreting the phrase 'capable of production'. It may be restricted to single shift production or may refer to second or third shift potential. Number of days to be worked within a year, number of shifts within a day, and number of hours within a shift have to be clearly specified if a clear picture of the capacity existing in a plant has to be ascertained. Without this definition it is meaningless to talk about capacity since a plant working in two shifts or 300 days in a year will be having a much lower capacity than plant working in three shifts or for 350 days in a year. While most of the time 'capacity' is used without any qualification, even when words like rated, installed and attainable capacities are used, they are not explained and are given different interpertation by different people and many a time used interchangeably. Even the Committee on Public

Undertakings, while using words like designed, rated and attainable capacity has failed to give an explanation of these terms and has not distinguished between designed, rated and installed capacity.[1]

Licensed Capacity : Licensed capacity is the capacity for which a firm has obtained a license from the issuing authorities. Industrial Development and Regulation Act of 1951 requires every medium or large industry to obtain a license from the government for setting up a new firm or for substantial expansion of existing capacities.

Design Capacity : After the license is obtained, the job of erection or supply of the plant is given to a manufacturer or supplier, who designs a plant for certain capacity. Designed capacity of the plant is a technical factor and therefore may not be equal to licensed capacity.

Installed Capacity : When the plant is erected, the manufacturer and management, after satisfying themselves that plant is properly installed according to specifications, declare the installed capacity of the plant. This is the maximum possible output which can be produced by that plant. This installed capacity may or may not be equal to licensed or designed capacities. An entrepreneur might have obtained the license in order to pre-empt the industrial capacity and avoid competitive entries. He may, therefore, decide not to install the capacity licensed and thereby exercise his monopolistic position to earn excess profit. Technical reasons may also create a difference between the installed capacity and the capacity licensed or designed. Due to indivisibility of machines, plant may have to be established with a capacity larger or smaller than the licensed capacity. Technical defects or deficiencies during installation, might keep installed capacity below the designed or licensed capacity. For instance, in the Trombay Unit of Fertilizer Corporation of India the installed capacity of the Nitrophosphate plant was much less than the licensed capacity and the capacity for which the supplier (inexperienced in erecting such a big plant) had designed the plant. The licensed and designed capacity of the Trombay plant was 900 metric tonnes of Nitrophosphate per day, the capacity installed was not even 600 metric tonnes. The contract for setting up the plant was awarded to a firm in U.S.A., because the terms of aid required that contract should be given to an American firm. But no firm in U.S.A. had an

1. Committee on Public Undertakings, Fifth Lok Sabha, Fortieth Report, 1973-74, pp. 64-88

experience of setting up such a large Nitrophosphate plant, while many European firms had the knowhow and the experience.[2] Similarly, the installed capacity of the Double Salt plant in Sindri unit was only 347 metric tonnes a day, instead of 400 tonnes licensed and designed, due to technical defects in installation.[3]

Rated Capacity : Rated capacity refers to the maximum production which a given plant is capable of producing under conditions prevailing in a country. Though, generally, rated capacity is equal to the installed capacity, yet due to climatic conditions or any other factor, it may not be possible to achieve, with a given plant, that level of output, which it is capable of producing in a different country or under different set of conditions. Rated capacity is the ideal capacity under given conditions. Generally, the distinction between installed and rated capacity is not maintained in India and firms equate the rated capacity with the installed capacity.

Attainable Capacity : Though rated capacity is the output which can be produced under ideal conditions existing at the time when plant was installed and capacities rated, certain unforeseen and uncontrollable factors may cause a shift in these ideal conditions. If these factors are of a permanent nature, and the rated capacity of the plant can never be achieved (unless the whole plant is restructured), the capacity of the plant will have to be re-rated. The maximum possible output under the changed circumstances is called the 'attainable capacity'. The factors which may cause this change in the capacity, can be for instance, ageing of the plant as it approaches its useful life, or deterioration in the quality or availability of certain feedstocks. An example of this is the Sindri Unit of FCI, where the installed capacity of the plant is 117 thousand tonnes of Nitrogen per year, the attainable capacity has been put at 99 thousand tonnes of Nitrogen by Kasturirangan Committee.[4] This is due to various factors. Deterioration in the quality of coal (good quality coal going to steel factories) has resulted in shortages of coke oven gas which in turn leads to shortages in Ammonia plant, with the consequent fall in capacity in all the nitrogenous fertilizer plants—Ammonium Sulphate, Nitrate and Urea. Low quality of

2. Committee on Public Undertakings, Fourth Lok Sabha, Twenty-sixth Report, 1968, Para 230 to 248.
3. Estimates Committee, Second Lok Sabha, Twelfth Report, Sindri Fertilisers and Chemicals, 1960-61, pp. 6-7.
4. Committee on Public Undertakings, Fifth Lok Sabha, Fortieth Report, 1973-74, p. 69.

gypsum has further aggravated the problem of Ammonium Sulphate plant. The rated capacity of this plant is based on good quality of gypsum obtained from fields which have subsequently gone to Pakistan. After partition, gypsum obtained from fields in Rajasthan is of a much lower grade affecting the production of Ammonium Sulphate. As a consequence, the attainable capacity of the plant had to be de-rated from 355 thousand tonnes to 320 thousand tonnes per annum.[5]

Just as attainable capacity can be lower than the rated capacity due to certain unfavourable changes in conditions of production, increase in the levels of efficiency or technical progress or availability of better feed-stock can lead to an increase in attainable capacity.

Available Capacity: However, even attainable capacity may not be available for certain period of time due to factors such as nonavailability of power, feedstocks, spares. Fall in output in one part of the plant may also constrain the capacity available in the main plant. These factors are of a temporary nature and may exist for a few months or even few years. But they do not permanently reduce the capacity of the plant, which can be attained the moment supply of above inputs is restored. But till then, the available capacity will be much less than the attainable capacity. This can be called the 'available capacity'. It is the maximum output that can be produced in a particular period within a given set of conditions.

Non-availability of power has reduced the available capacity of the Nangal and Gorakhpur Units for the last few years.[6] Non-availability of spares in the new Ammonia plant at Sindri for a few years reduced the available capacity of the plant from 330 stream days to 285 stream days in a year.[7]

Underutilisation of Capacity

Actual capacity utilisation may not be equal to available capacity for

5. Committee on Public Undertakings, Third Lok Sabha, Sixth Report on FCI, 1965, pp. 10-11. Also Annual Reports of FCI.
6. Annual Reports, Fertilizer Corporation of India.
7. Estimates Committee, First Lok Sabha, Thirteenth Report, 1954-55, p.5.

various reasons. It may be due to factors beyond the control of management such as demand being lower than supply. Shortfall in capacity utilisation due to demand can be termed as excess capacity in an industry or a firm. Excess capacity of a plant may be a permanent feature if the capacity installed was higher than the demand and continues to be so. It may, instead, be a temporary phenomenon due to periodic fluctuation in demand. While the former is a situation of chronic excess capacity, the latter does not fall into this category and strictly speaking, cannot be called excess capacity. It is only a temporary fall in demand resulting in underutilisation of available capacity. Apart from this, as a deliberate policy, an entrepreneur interested in monopoly gains may restrict production through underutilisation of the available capacity.

Another factor contributing to low utilisation of available capacities is inefficiency in production and management. Unscheduled breakdowns of plant and machinery, unscientific materials management (resulting stock out of materials), bad industrial relations, lack of proper organisation, etc., may all result in underutilisation of available capacity and lower output. Causes of underutilisation of capacity may be numerous, some falling within the decision range of policy-makers and some of management. An example of how policy decisions effect utilisation of capacity can be had from Sindri fertilizer factory where production of ammonia suffered on account of delay in the release of foreign exchange required for some essential spare parts.

Hidden Capacities

While production is generally equal to the attainable or available capacity, in certain cases, it has been observed that capacity utilisation is more than 100 percent. It is surprising how actual production can be more than maximum possible (available capacity). Three factors can explain this. Firstly, it is possible that the rated, attainable or available capacities were worked out on a single shift basis, while, in fact the factory might have been operating in more than one shift. Similar situation may arise if working hours were more than those on which capacities were worked out. Secondly, it is possible that the industry had certain hidden capacities which were not declared either by the supplier when the plant was installed or by the management when capacities were assessed. Under the circumstances,

the actual rated, attainable and available capacities can be much higher than those declared. Thus, it follows that when the full potential of the plant is taken into account, the unit which claims to be working above full capacity might as well be revealing underutilisation of capacity. Thirdly, it could also be that after attainable capacities were assessed, there has been improvement in the efficiency of labour, or quality of raw material etc., leading to a situation where the actual utilisation is higher than the attainable capacity.

Assessment of Capacity Utilisation

It is, therefore, necessary that whenever capacity utilisation is worked out the relevent concepts should be made specific and clear. Otherwise it may give a misleading picture of the actual situation prevailing. Whether capacity utilisation should be worked on the basis of designed, installed, rated, attainable or available capacities will depend upon the purpose of the study. For instance, if the purpose is to assess the efficiency of production and management, utilisation should be with reference to the available capacity. If, on the other hand, we are concerned about the various factors accounting for lower utilisation we may have to compare actual utilisation with designed, rated, attainable and available capacities.

Capacity Utilisation and Profitability

Capacity utilisation has its impact not only on productivity of labour and capital but also on costs and profits. Once a firm has installed some capacity, lower utilisation of this capacity does not bring about a proportionate reduction in costs. The case of fixed costs is obvious. Even 'variable costs,' like wages do not go down proportionately with production. In fact, when labour is recruited in accordance with the requirements of full capacity utilisation and retrenchment is difficult, labour costs become fixed costs and do not decline with reduction in output. Same is the case with administrative and other overhead expenses. Only costs that go down are material, power and fuel costs. Even here proportionate reduction is not possible as certain consumable stores and spares become fixed costs once production is undertaken.

Table 1: Capacity Utilisation In Major Fertilizer Units In India

Units	Nitrogen (N) Capacity Utilisation		Utilisation as percentage of Rated Capacity						Utilisation as a percentage of Attainable Capacity					
	Rated Capacity (in '000 Tonnes)	Attainable Capacity (in '000 Tonnes)	68-69	69-70	70-71	71-72	72-73	73-74	68-69	69-70	70-71	71-72	72-73	73-74
FCI Sindri	117	99	65.0	68.0	64.0	63.0	52.0	60.0	77.0	80.0	76.0	75.0	61.5	70.7
FCI Nangal	80	88	96.0	100.0	67.5	70.0	66 0	77.5	96.3	100.0	67.5	70.0	66.0	77.5
FCI Trombay	81	81	67.0	56.0	67.0	75.0	78.0	79.8	67	56.0	67.0	75.0	78.0	79 0
FCI Gorakhpur	80	80	60.0	91.0	85.0	95.0	86.0	80.0	60	91.0	85.0	95.0	86.0	80.0
FCI Namrup	45	45	27.0	57.0	62.0	67.0	77.7	80.0	27	57.0	62.0	67.0	77.7	80.0
FACT Alwaye	80 upto 1969 82	64 upto 1969 67	44.0	39.0	40.0	48.0	37.0	43.0	55.0	48.0	49.0	58.0	45.0	52.0
Madras State Fertilizer	164	190	—	—	—	61.0	64.0	N.A.	—	--	---	53.1	55.3	N.A.
Rourkela Fertilizer	120	115	41.0	25.0	20.0	40.0	41.0	N.A.	42.4	26.0	21.0	41.0	42.4	N.A.
Neyeli Lignite Corporation	70	40	58.7	60.0	45.7	28.6	30.0	N.A.	102.7	105.0	80.0	50.0	52.5	N.A.
Gujarat State Fertilizer	216	221	32.0	51.0	69.0	86.0	94.0	N.A.	32.0	50.0	67.0	84.0	92.0	N.A.
Coromandal Fertilizer	80	80	65.0	85.0	76.0	81.0	74.0	N.A.	65.0	85.0	76.0	81.0	74.0	N.A.
Sri Ram Fertilizer	110	120	—	74.5	103.0	98.0	115.0	N.A.	—	68.0	94.0	90.0	106.0	N.A.
Indian Explosives	200	200	—	—	53.5	64.0	78.0	N.A.	—	—	53.5	64.0	78.0	N.A.

Sources : (1) Fertilizer Satistics, Fertilizer Association of India, 1972-73. p. 101.
(2) India Fertilizers & Chemicals, Economics & Statistics Division. Ministry of Petroleum & Chemicals, Government of India. 1972, pp. 141-146.
(3) Committee on Public Undertakings, Fifth Lok Sabha, Fortieth Report, 1973-74.
(4) Annual Reports of Companies.

Table 2 : Utilisation of Capacity and Cost Reduction

Unit	Year	Capacity Utilisation (In Per cent)	Cost per unit at existing level of output			Cost per unit with full utilisation		Reduction in cost percentage of output at full capacity	Underutilisation of capacity (percentage)	Decline in profit or Increase in cost per unit of output for every 1% underutilisation of capacity	Decrease in Profit per unit of output in N: for every 1% under utilisation of capacity (average)
			V. Cost	Fixed Cost	Total Cost	F. Cost	Total Cost				
	1	2	3	4	5	6	7	8	9	10	11
A	1963-64	96.4	123.20	87.3	210.50	84.20	207.40	3.10	3.63	0.86	4.20
	1964-65	95.9	122.30	89.0	211.30	85.50	207.80	3.50	4.10	0.88	4.28
	1965-66	87.1	121.77	99.5	221.27	86.60	208.37	12.90	12.90	1.00	4.88
	1966-67	90.3	127.16	102.4	229.78	92.67	219.83	9.95	9.70	1.03	5.01
	1967-68	86.7	127.27	100.6	227.87	87.25	214.52	13.35	13.27	1.01	4.91
	1968-69	96.6	158.00	127.0	285.00	122.70	280.70	4.30	3.40	1.26	5.06
	1969-70	99.6	161.00	125.0	286.00	124.50	285 50	0.50	0.40	1.25	5.00
	1970-71	67.3	172.00	191.0	363.00	128.60	300.60	62.40	32.66	1.97	7.64
	1971-72	70.0	193.00	192.0	385.00	134.40	327.40	57.60	30.00	1.92	7.68
	1972-73	67.7	193.00	137.0	330.00	92.70	285.70	44.30	32.34	1.37	5.48
B	1969-70	90.9	266.00	329.0	595.00	299.00	565.00	10.00	9.10	3.30	7.16
	1970-71	84.7	329.00	336.0	665.00	284.50	613.50	51.50	15.30	3.36	7.16
	1971-72	95.0	336.00	324.0	660.00	308.00	644.00	16.00	5.00	3.13	7.00
	1972-73	86.6	373.00	376.0	750.00	325.50	698.50	50.50	13.40	3.77	8.19

Source: Profit & Loss Accounts and F.C.I.

Since above fixed costs account for a significant proportion of the total cost, higher utilisation would bring about considerable reduction in the costs per unit of output. It is also important to note that profits increase not only because of reduction in costs but also because they are earned on output which was not produced when capacity was underutilised.

Capacity Utilisation: Nitrogeneous Fertilizers in India

Utilisation of rated and attainable capacity of nitrogenous fertilizers in India varies from 20 percent in certain years in some units to more than 100 percent in some other units. Due to non-availability of data regarding available capacity in various units, capacity utilisation has been worked out on the basis of rated and attainable capacities. Table I indicates the capacity utilisation in major fertilizer units in India.

The above table brings out that capacity utilisation is as low as 20 and 21 percent of rated or attainable capacity respectively in the year 1970-71 for Rourkela fertilizer factory and does not show sign of much improvement. Alwaye unit of Fertilizers and Chemicals, Travancore, also has a very low rate of capacity utilisation, ranging between 37 to 48 percent of rated capacity and 45 to 58 percent of attainable capacity. Among the public sector enterprises, rate of utilisation appears to be highest in Nangal and Gorakhpur, ranging between 60 to 100 percent of rated/ attainable capacity* in different years. Among the private sector units, the best performance in capacity utilisation is that of Sri Ram Fertilisers where utilisation has even gone beyond 100 percent. Gujarat State Fertilizers has been showing a constant improvement, starting with a low percentage of 32 percent in the initial years to about 94 percent of rated capacity in 1972-73. Indian Explosives, a unit of recent origin, has also been showing fast improvements.

An idea of the extent to which underutilisation of capacity increases costs per unit of output and thus reduces profits can be had from Table 2 relating to two units of Fertilizer Corporation of India.

The above table indicates the exent by which costs can decline and profits increase if full utilisation of capacity is achieved. While col. 2

*Rated Capacity being equal to Attainable Capacity.

gives percentage utilisation of capacity in relation to rated/attainable capacity, cols. 3, 4, 5 give variable, fixed and total costs respectively per unit of output for that level of utilisation. Cols 6, and 7 give fixed and total costs per unit of output if full capacity utilisation had taken place. All costs, except materials, power and fuel have been assumed fixed for reasons mentioned earlier. Out of material costs, costs of certain spares have also been taken as fixed as they are a fixed charge on production irrespective of the level of the output. Costs given in the above table also exclude costs like those on township, publicity, training, etc., as they do not contribute to increasing production. It also excludes excise duty and sales expenditure.

Since the price of the product is fixed by the government, we can safely assume that if costs decline profit per unit of output would increase to the same extent. Col. 8 shows decline, in costs per unit of output and therefore increase in profit per unit of output, if production is at full capacity. It brings out that profit in unit A would have increased by Rs. 62, 57 and 44 per unit of output at full capacity utilisation for the years 1970, 1971 and 1972 respectively. Converted into cost per unit of nitrogen, the increase in profit would be still larger, i. e., Rs. 248, 228 and 176 per unit of nitrogen. Similarly, in unit B, in 1970 and 1972 increase in profit per unit of nitrogen production would have been about Rs. 112 and 110 respectively.

Col. 10 shows increase in cost or decline in profits per unit of output for every one percent underutilisation of capacity on an average. Col. 2 shows the above change in cost and profit per unit of Nitrogen (N) production. In the case of unit A, every one percent underutilisation of capacity increases costs by about Rs. 5 per unit of nitrogen production if capacity utilisation is lower by 15 percent or less. Cost per unit of 'N' increases by Rs. 5.57 to Rs. 7.50 if capacity utilisation is lower by about 30 percent. Similarly, in the case of Unit B, one percent under-utilisation of capacity reduces profits by about Rs. 7 to 8 per unit of 'N' when capacity utilisation is lower by 15 percent or less.

The Committee on Public Undertakings[8] has brought out a similar fact in the case of Sindri Unit of FCI. Its new cost of producing Ammonium Sulphate would have been lower by Rs. 33·75 per unit in 1963-64 if

8. Committee on Public Undertakings, Fourth Lok Sabha, Forty-third Report, 1968-69, p. 12

production were equal to rated capacity. Similarly, cost of producing double salt would have been less by Rs. 107.70 per unit and that of Urea less by Rs. 75.80 per unit with full capacity utilisation. A major reason for underutilisation of capacity in many units of FCI has been shortages in power supply, specially for the last 4-5 years. Committee on Public Undertakings[9] has stated that Gorakhpur Unit could "work even in excess of capacity provided U. P. Electricity Board met the power requirements in full".

Conclusion :

To sum up, technical defects in installation, non-availability of materials of requisite quality, shortages in power supply, unscheduled break-downs, disturbances in industrial peace and so on, have contributed to underutilisation of capacity in different fertilizer units in India. This has accounted for a significant increase in cost of production and reduction in profitability.

9. Committee on Public Undertakings, Fifth Lok Sabha, Fortieth Report, 1972-73, p.69.

Capacity Determination Through Linear Programming

S. A. Khader

The normal production processes of an engineering unit include foundry and forge, fabrication, machining, finishing, assembly and packing. Unlike a chemical process plant, where various ingredients of the product go through various vessels and pipelines in a closed loop, to form an end product, the engineering product gets shaped through the assembly a number of components which undergo a series of operations through the above processes. Hence, the capacity determination for engineering enterprises poses certain problems mainly due to this nature of the industry. The capacity determination in terms of either number of products or quantum of products in tonnes etc., is rather a difficult task, while the capacity in terms of basic units, like tonnes of molten metal processed in a foundry, machine hours or work centre hours of machine shop and man-hours available in an assembly shop can be easily arrived at.

In mass-producing plants, discrete product lines exist, with all work-centres balanced and arranged in a line to facilitate streamlined flow of materials to form the finished products. For such units the capacity in terms of physical output can be very easily arrived at by identifying the critical (bottleneck) work centres.

A general engineering unit when it is aimed to produce various products in batch quantities, the normal approach is to have process type of shop layout, wherein separate shops for foundry and forge, fabrications, machining, assembly and finishing are planned, as this would facilitate effective shoploading and utilization. The capacity determination for unit producing a variety of products, by manual computations is very cumbersome and time-consuming. The quantitative techinque, viz., Linear Programming will be of great help to the planner to monitor for the capacity utilization.

Changes in product design and diversification are normal features of job-type of engineering industries. The raw-material and bought-out component availability, labour relations, etc., are some of the factors that influence the production capacity at a time. Under these conditions

of frequent changes in the production pattern, the capacity assessment of a general engineering unit cannot be a static exercise. It has to be done more frequently—may be quarterly or monthly. This is possible with the quantitative techniques, which are computer based.

Capacity Model

The normal manufacturing activity of an engineering unit can be represented in a matrix :

Work Centre / Products	WC_1	WC_2	WC_3	WC_j	WC_n	*Number of Products*	*Profit Margin*
P_1	t_{11}	t_{12}	t_{13}	t_{1j}	t_{1n}	N_1	$(PM)_1$
P_2	$t_2{}^1$	t_{22}	t_{23}	t_{2j}	$t_2{}^n$	N_2	$(PM)_2$
,	,	,	,	,	,	,	,
,	,	,	,	,	,	,	,
,	,	,	.	,	,	,	,
P_i	,	,	t_{i3}	t_{ij}	,	N_i	$(PM)_i$
,	,	,	,	,	,	,	,
,	,	,	,	,	,	,	,
P_m	$t_m{}^1$	tm^2	t_{m3}	t_{mj}	t_{mn}	N_m	$(PM)_m$
Basic Capacity	$(WC)_1$	$(WC)_2$	$(WC)_3$	$(WC)_j$	$(WC)_n$		

WC_j	j-th work centre where j varies from 1 to n
P_i	i-th product where i varies from 1 to m
t_{ij}	process time per unit of product i at work centre j (machine hour/man hour). This includes the setting time and other incidentals.
$(WC)_j$	Annual capacity of work centre j in terms of machine or man hours
N_i	Number of i-th product to be manufactured in a year.

This matrix is applicable to any type of an engineering industry, whether it is light, medium or heavy and its production pattern is project type, small batch or mass production.

This mathematical model can be put to various uses. One such derivative of this model would be to determine the number of products (Ni), by solving the above matrix with a suitable objective function. Thus this becomes a linear programming problem. For illustration, let us consider the case of Profit Optimization :

Objective function $= \sum_{i=1}^{m} N_i (PM)_i$

With the constraints

(i) Work Center Capacity $\sum_{\substack{i=1 \\ j=1}}^{\substack{i=m \\ j=n}} N_i . t_{ij} \leqslant (WC)_j$

(ii) Market $(N_i)min \geqslant (N_i) \leqslant (N_i)max.$

When the matrix is large, this linear programming problem has to be solved with the help of a computer to find out the number of each of the products (Ni) that lies between maximum [(Ni) max.] and minimum [(Ni) min.] market demands of the product. Thus the capacity of the unit can be found out in physical terms, either in number of each products or in terms of tonnage of the products by multiplying the number (Ni) with the respective unit weight. This model has certain underlying assumptions:

1. This model assumes that no constraint other than market demand would impede the continuous production.
2. All factors considered are assumed to have only linear influences on production.
3. The sequencing problems of scheduling and ensuing forced idle time on the part of certain work-centres if any, are not considered.

It is possible to solve the same model with other optimising functions such as (i) maximum utilisation of capacity (ii) maximization of tonnage

etc. Other input and output constraints of material, labour capital etc., could also be imposed to adapt the solution to the real situation.

Data Collection for the Model

To achieve the objective of determination of capacity with the help of this model, it is necessary to ensure the availability of right type of data. The data required for the model is very basic and is normally available within an enterprise. Even if the data is not available, it is possible to develop the same in a short period of time with the available records.

Work-Centre Capacity $(WC)_j$: The basic capacity at each work-centre is to be measured in an appropriate unit. A few examples are indicated below:

Work Centre	*Unit of Capacity*	*Capacity Depends on*
Pattern making	man hours	No. of pattern makers
Moulding	man hours	No. of moulders
Melting	tonnes of metal/hour	No. of furnaces
Fettling	men/machine hrs	No. of men/machines
Turning	m/c hrs.	No. of machines
Drilling	"	"
Milling	"	"
Grinding	"	"
Assembling	man hours	No. of Assemblers

But in an enterprise, the number of work-centres may range anywhere from 25 to 100, including all the unique, special and general-purpose processes. To arrive at the capacity at each work centre, it is necessary to consider all the factors that influence the effective available time, namely, the number of hours of work per shift; normal shifts of working,

down time for maintenance, absenteism and other factors that reduce the available time, e.g., Work Centre Hour Capacity of Milling :

Number of working days in a year	=300
No of shifts	=2 (8 hours each)
Scheduled breaks	=Half an hour per shift
Down time (Maintenance & Unavoidable)	=10%
Number of Machines	=12
Manning	=Full
Annual Capacity	=12 x 300 x 2 x 7.5 x 0.90
	=47,600 Machine hrs.

Such data is normally available in the planning department. This data forms the important constituent of the model.

Products (Pi) and Market Demand : A typical engineering unit may have certain branded products for which there exists a well-established market demand or share of the market, which may vary between certain maximum and minimum limits. For the products/projects and job-work for the period under consideration, the maximum and minimum demands could be worked out in consultation with the marketing and planning departments.

In the situation where management has a policy to reserve a portion of its capacity for certain special jobs like developmental projects, engineered items, diversification, small batch products and other special products, it is necessary to reduce the work centre hour capacity correspondingly.

Time Data (tij) : This information happens to be the crux of the model. When time standards for all operations are not available either through estimation or study, it is not possible to utilize this model. Usually an

engineering unit has well established Work Study and Production Planning departments. t_{ij} is to be developed from time standards for all the operations taking place in j-th work centre on all the components sub-assemblies of i-th product. This data is mostly available either in the planning department or work-study department. In the case of projects or custom-built products, this data will be available in the technology and/or estimating department. This is likely to be approximate, but good enough for the exercise.

Objective Function : Objective function which is the primary function of a linear programming model, has to be judiciously selected, keeping in mind the end use of the results. Some possible alternatives are : (i) profit (ii) utilisation, (iii) number of products (iv) tonnage etc. Each of these have their relative advantages and uses.

Thus, the data relevant to the objective function will have to be collected, e. g., profit margin per unit product for profit-maximization.

Cases of Application

The following case studies illustrate the application of the model towards capacity determination.

A. *Construction Equipment/Machinery Building Plant* : A unit engaged in manufacturing equipments and machines for construction industry faced with the problem of assessing its capacity in terms of number of equipment/machinery that could be produced with the available resources. This has been solved by using the linear programming model, the time utilisation of work-centres as the objective function and imposing the constraints of market demand and basic work-centre capacity. The following computer print-out will give the capacity of the unit in terms of number of products.

Table 1 : Linear Programming Model Solution : Work Centre Capacity Constraints

S. No.	ROW (Work Centre)	AT	ACTIVITY (Extent Utilized)	SLACK ACTIVITY (Unutilized)	LOWER LIMIT	UPPER LIMIT (Capacity available)
1.	PROD	BS	3550895	3550895	NONE	NONE
2.	CON_1	BS	490758	317644	,,	808402
3.	CON_2	BS	305849	21046	,,	326895
4.	CON_3	BS	146810	78482	,,	225292
5.	CON_4	UL	46980	—	,,	46980
6.	CON_5	UL	30922	—	,,	30922
7.	CON_6	BS	48869	57151	,,	106020
8.	CON_7	BS	130155	6787	,,	136942
9.	CON_8	BS	68933	37087	,,	106020
10.	CON_9	BS	21920	4585	,,	20505
11.	CON_{10}	BS	31562	17030	,,	48592
12.	CON_{11}	BS	10224	1628	,,	26505
13.	CON_{12}	BS	2217913	65716	,,	2875080
					TOTAL	4764155

Utilisation of resources $= \frac{3550844}{4764155} = 74.5\%$

Table 2 : Optimum Production Capacity

S. No.	Column (Products)	AT	ACTIVITY (Production)	IPUT COST	LOWER LIMIT (Min. Demand)	UPPER LIMIT (Max. Demand)
14	X_1	LL	70	5855	70	119
15	X_2	BS	74	6766	70	92
16	X_3	LL	89	8093	89	96
17	X_4	UL	41	8175	4	41
18	X_5	UL	89	8175	60	89
19	X_6	UL	20	9475	—	20
20	X_7	UL	54	5002	14	54
21	X_8	BS	21	3895	9	32
22	X_9	UL	72	4372	45	72
		Total Production	530			

B. *Machine Tool Manufacturing Factory* : An engineering unit specializing in manufacturing machine tools, is dependent on outside supplies of castings and certain sub-assemblies. It has encountered the problem of capacity determination. The application of this model with time utilisation as objective function revealed that the unit can produce in all 155 machine tools per annum, distributed over the normal product range as indicated in the following computer print-outs.

Table 3 : Linear Programming Model Solution : Work Centre Utilisation Constraints

ROW (WORK CENTRE)	*AT*	*ACTIVITY (Extent Utilised)*	*SLACK ACTIVITY (Unutilised)*	*LOWER LIMIT*	*UPPER LIMIT*
PROD	BS	478221	478229	NONE	NONE
CON_1	BS	109004	107236	,,	216240
CON_2	UL	33920	—	,,	33920
CON_3	BS	66257	69423	,,	135680
CON_4	BS	7692	13507	,,	21200
CON_5	BS	66702	45538	,,	110240
CON_6	BS	56402	24158	,,	80560
CON_7	BS	2858	5622	,,	8480
CON_8	BS	37470	34610	,,	72080
CON_9	BS	33771	34069	,,	67840
CON_{10}	UL	21200	—	,,	21200
CON_{11}	BS	32446	9954	,,	42400
CON_{12}	UL	16970	—	,,	16960
				Total	826800

$$\% \text{ Time Utilisation} = \frac{478221}{826800} = 57{\cdot}84\%$$

Table 4 : Linear Programming Model Solution : Optimum Production

COLUMN (Products)	*AT*	*ACTIVITY (Production)*	*INPUT COST*	*LOWER LIMIT*	*UPPER LIMIT*
X_1	LL	10	1258	10	25
X_2	BS	24	1720	10	25
X_3	UL	30	2595	15	30
X_4	UL	30	2994	15	30
X_5	BS	1	1528	—	none
X_6	BS	25	4460	25	40
X_7	LL	20	4537	20	40
X_8	LL	15	3419	15	40
	Total	155			

The above computer print-out (column marked '*Slack Activity*') indicates the bottleneck work-centres, which have limited the production. By debottlenecking these centres, that is by adding additional equipment or facilities, it is possible to increase production, as indicated below :

Table 5 : Computer Run with Debottlenecking

(Figure in bracket indicates the additional machinery)

ROW	*AT*	*ACTIVITY*	*SLACK ACTIVITY*	*LOWER LIMIT*	*UPPER LIMIT*
PROD	BS	757130	757130	NONE	NONE
CON_1	BS	157218	59022	"	216240
CON_2	BS	69200	2880	"	72080
CON_3	BS	127226	8454	"	135680
CON_4	BS	8448	12752	"	21200
CON_5	BS	101414	8826	"	110240
CON_6	UL	80560	—	"	80560
CON_7	BS	4977	3503	"	8480
CON_8	UL	72080	—	"	72080
CGN_9	BS	62011	5829	"	67480
CON_{10}	BS	25657	—	"	25440
CON_{11}	UL	42400	—	"	42400
CON_{12}	BS	32950	—	"	33920
				TOTAL	886160

% Time Utilisation : $\frac{757130}{886160} = 85.6\%$

Table 6 : Computer Run with Debottlenecking

COLUMN	*AT*	*ACTIVITY*	*INPUT COST*	*LOWER LIMIT*	*UPPER LIMIT*
X_1	LL	8	1258	8	NONE
X_2	BS	176	1720	12	"
X_3	LL	18	2595	18	"
X_4	LL	19	2994	19	"
X_5	BS	22	1528	20	"
X_6	BS	52	4460	25	"
X_7	LL	15	4537	15	"
X_8	LL	—	3489	—	"
	TOTAL	310			

This clearly shows that it is possible to double the production to 310 m/c tools by marginally adding a few equipments (14 nos.) The de-bottlenecking of work-centres pushes upto 85·6 per cent as against 57.84 per cent earlier. Such exercises are possible and can be done with the help of this technique.

Conclusion

An established model of this type would go a long way not only to determine the production capacity, but also aiding the management in monitoring the capacity utilisation. This model can further be adopted to embrace the other constraints of industrial capacity utilisation, namely, material availability, labour unrest, capital and others.

Underutilisation of Capacity in Indian Industries : 1969-73

Hardip Singh

The importance of optimum utilisation of industrial capacity can hardly be over-emphasised, especially, in a developing economy where the availability of productive resources is acute. In economic literature, growth is normally associated with new investment, but it is as well important that these 'investments' contribute their maximum possible yield to the economy. Through better utilisation of installed capacity, the economy can bring down the prevailing capital output ratios and capital-labour ratios, resulting in more employment, more income and more competitiveness in export markets without much additional capital expenditure.

In a mixed economy like India, to some extent, excess capacity is bound to arise even if the planning and implementation process is near perfect. This calls for studying the problem from time to time, and in the light of such studies, re-structuring the edifice of industrial policy.

The present exercise attempts to study the problem of underutilisation during 1969-73; analyse the constraints in the process of effective utilisation, and in the light of this exercise focus a perspective look in the near future.

Background

The problem of underutilisation in industries did not seize the attention of authorities during the first two plans. Even during the foreign exchange crisis of 1958, industrial sector in India was able to utilise about 90 percent of its capacity. The index of average utilisation of capacity for 40 major commodities, was around 75 percent in 1953, which rose to 92 percent in 1957 and after declining to 89 percent in 1958, recuperated to the level of 92 percent in 1959[1]. The annual

1. Morris Budin and Samuel Paul : The Utilisation of Indian Industrial Capacity 1949-59, *Indian Economic Journal* July, 1961.

growth rate of capacity expansion ranged between 1.3—2.8 percent during this period and index of production rose from 103.6 in 1952 to 151.5 in 1959. But in sixties, the position started deteriorating and a study conducted by Reserve Bank of India[2] showed that underutilisation of capacity in selected industries was about 17.7 percent in 1963, and 21.4 percent in 1967. The rise in underutilisation of capacity was more pronounced (from 12.7 percent to 23.2 percent) in metal and engineering industries.

Capacity Utilisation in the Fourth Plan

In such a situation, it was but natural that the Fourth Five-Year Plan (1969-70 to 1973-74) was launched with an objective, "to bring about conditions, within which the maximum utilisation of capacity already built-up is achieved."

The draft Fourth Five-Year plan envisaged an annual growth rate of 8-10 percent in industrial output. This obviously looks a very modest target in the light of the fact that at that time India's industrial sector had the potential to achieve an annual growth rate of 6-8 percent only by using the existing capacity fully, even without changing the existing shift pattern. However, the actual performance of this sector was about 4 percent, i.e. less than half of the target. The rate of capacity expansion at the same time is estimated around 4-5 percent per annum. Obviously, on the whole there was no improvement in the capacity utilisation during this period. According to one estimate, the rate of capacity utilisation decreased from 78 percent to 70 percent over the fourth plan period.[3]

However, the situation got worse only towards the end of the Fourth Plan. In the first year, the performance was moderate, underutilisation being around 20 percent. In the next year, there was some improvement, for several industries were working either to full capacity or near full capacity. To name a few, they are transformers, electrical motors, storage batteries, electrical measuring instruments, H.T. insulators, ball

2. Excess capacity and Production Potential in Selected Industries in India, *Reserve Bank of India Bulletin*, April 1969.

3. *Annual Review* 1974-75 : Government of India.

and roller bearings, plastic working machines, twist drills, aluminium, copper, caustic soda, soda ash, paper and paper boards, automobile tyres and tubes etc. Industries which were suffering from underutilisation even at that time were steel, heavy engineering and transport equipment. Utilisation of capacity in steel industry was about 67 per cent. In the third year of the Fourth Plan, the situation remained almost the same. But in the fourth year, there was a noticeable change. Most marked improvement was in basic industries such as finished steel, steel castings, aluminium and phosphatic fertilisers. Capital goods like railway wagons, machine tools, electrical equipment etc., also recorded an increase in capacity utilisation in this year. However, the last year, washed away most of the gains of the earlier period. Still there was a noticeable improvement in case of the following industries over the five year period :

Table 1 : Capacity Utilisation

(*Percent*)

Industry	*1969*	*1973*
Structurals	27*	31
Steel Castings	38	43
Aluminium (sheets & circles)	58	74
Copper (sheets & circles)	54	76
Motor vehicles	105	136
Machine tools	39	88
Tyres and tubes (automobile)	98	116
Ceramics	61	106

*for 1971.

Source : 1. for 1969 : Monthly Statistics of Industrial Production

2. for 1973 : Currency and Finance Report 1973-74, RBI

On the other end many industries recorded a decline in capacity utilisation over the period. Some of the important industries where utilisation deteriorated are cement (88 percent to 76 percent), soda ash (98 percent to 92 percent), railway wagons (49 percent to 35 percent), electric motors (81 percent to 50 percent), paper mill machinery (80 percent to 31 percent), storage battery (122 percent to 97 percent), etc.

In the case of consumer goods, no clear terms could be established. The rate of capacity utilisation remained fluctuating from year to year. The range of fluctuations for some of the major industries during the period of study can be guaged from table 2

Table 2 : Fluctuation in Capacity Utilisation (Present)

Industry	*Low*	*Average*	*High*
Radio Receiver	62	81	148
Bicycles	60	71	94
Vanaspati	43	56	64
Soaps	97	130	189
Matches	72	93	108
Footwear Leather (W. style)	51	105	177
Hurricane Lanterns	76	104	130

Thus, although it is very difficult to generalise for the industrial sector as a whole, there is no doubt that during this period substantial industrial capacity remained unutilised in almost all the sectors. While for Consumer Goods the utilisation was around 94 percent, for other sectors the situation was not good. In case of Basic Industries and Capital Goods Industries underutilisation ranged in the vicinity of 35-40 percent.

At this juncture it would be worthwhile to assess the capacity utilisation of various industries. On the one hand, in industries like motor-vehicles (125 per cent), soaps (130 per cent), electric lamps (137 per cent) capacity utilization was more than 100 per cent. For industries like caustic soda, soda-ash, power transformers, storage battery, dry cells, automobile tyres and tubes, etc., the utilization was around 100 per cent. Industries utilizing capacity in the range of 70 to 90 per cent are cement, aluminium (sheets and circles), copper (sheets and circles), electric motors, paints and varnishes, radio receivers, bicycles, footwears, rubber, electric fans and glasses and glasswares. In case of sulphuric

acid, nitrogeneous fertilizer, phosphatic fertilizers, machine tools, ceramics, vanaspati and cycle tyres average utilization varied between 50 to 70 cent, while for industries like structurals (30 per cent), steel castings (44 per cent), brass (sheets and circles—34 per cent), railway wagons (36 per cent), cement mill machinery (22 per cent), cycle tubes (38 per cent) etc., the average utilization during the period was below 50 per cent. Thus out of 42 industries studied the problem of under-utilization during the Fourth Plan was appalling in seven industries, acute in six, and moderate in ten industries.

Causes of Underutilization of Capacity

Factors which come in the way of effective capacity utilization in industrial sector can be grouped into two broad categories :

(i) those which effect the industrial sector generally as a whole, or almost all the industries in a particular region—such as power shortage, transport bottlenecks, licencing policies, law and order situation, etc. ; and

(ii) those, whose impact is normally restricted to a particular industry. This can be further divided into two :

(a) demand factors like lack of demand, uncertainties in demand estimation, price controls, etc.

(b) supply factors like shortage of raw materials, labour trouble, gestation period, etc.

Power Shortage

During the period under study, the most telling effect on capacity utilisation was caused by unprecedented power shortage. Power generation which had experienced growth rates ranging from 9-16 per cent every year for more than a decade, shrank for the first time towards the end of the period. While, during the plan period as a whole electricity generation increased at an annual rate of 6.4 percent (Plan target 10.7 percent) in 1973, it recorded a decline of 1.8 per cent. This wide-

spread scracity resulted partly from reduced development expenditure on power projects in the non-plan period and, partly from constant poor maintenance and operation of power plants. Failure of monsoon in 1972 and 1973 also affected the supply of power from Hydel plants pushing the whole economy out of gear.

The impact of this scarcity was widespread and deep. Firstly, almost all industries had to slice down their working schedule drastically. In the northern region, the cut in supply ranged between 50-70 per cent for some time. This meagre supply of power reduced the capacity utilisation in most of the industries. The performance of industries such as power transformers and electric motors was directly affected. In case of the former, utilisation slumped from 139 per cent in 1972 to 76 per cent in 1973 and for the latter it came down from 93 per cent to 50 per cent for the same period. The impact was deeper in the sense that the power performance of basic industries like coal and steel affected the performance of those industries as well, where the impact of power shortage was not much. Though almost all industries felt the strain of this shortage, the effect was severe, particularly, for steel, non-ferrous metals, cement, paper and paper products, cotton and jute textiles, fertilisers, soda ash and calcium carbide. In Jute industry alone loss in production due to power shortage is estimated at about 42 thousand tonnes and 68 thousand tonnes for 1972 and 1973 respectively.

During this period the occurance of transport bottlenecks was also quite high, particularly, in the eastern region. Any disturbance in the railway movement in this region causes a serious damage to the industrial sector through dislocation of coal and steel movements to the industrial plants.

Shortage of Raw Materials

Among the factors responsible for underutilisation of capacity the shortage of raw materials and components comes next in importance. The shortage of raw materials generally arises either due to poor performance of agriculture affecting the performance of agro-industries and cotton and jute textiles or because of restricted imports due to foreign exchange scarcity. A survey of 234 industrial units in 1966 showed

that about 53 products suffered from this problem alone, explaining about 47 per cent of underutilisation.[4] During the Fourth Plan period also, shortage of raw materials was experienced by industries. During the period, output of coal increased at an annual rate of 1.8 per cent, compared to the plan target of 5.6 per cent. The shortage of coal and power hit the steel industry. As a result the output of finished steel declined at an annual rate of about one per cent. Capacity utilisation in steel industry fell from 71 per cent in 1968–69 to 57 per cent in 1973-74.

The strains of shortage of these vital inputs were felt by a wide spectrum of industries. In addition, there were many other cases where the industry had to restrict the utilisation of full capacity due to inadequate supply of a particular input. In 1972, the performance of soap industry was effected adversely due to shortage of oils and restricted imports of tallow due to foreign exchange restrictions. Shortage of pulp was an obstacle in full utilisation of capacity in paper industry. There was a general scarcity of raw materials for chemical industry due to worldwide disturbances in oil trade. In 1973, the limited availability of furance oil resulted in partial or complete closure of many cement plants. A temporary shortage of raw jute in the months of May—July 1973 cast a telling effect on the industry's performance.

Industrial Relations

The economic and political conditions prevailing in the economy during this period were not conducive for amicable industrial relations. On the economic front, a swift upward trend in general price level gave rise to frequent labour troubles. On the political front, law and order situation was pretty bad partly due to economic disturbances and partly due to external hostilities. In this situation, the labour unions and the managements both resorted to irresponsible postures which resulted in an unprecedented rise in man-days lost. The total number of man-days lost due to strikes and lock-outs rose to about 20 *million a year during this period against 5.7 million a year in 1961-65 period* (see table). The loss was concentrated more in a few critical industries such as mines, railways, ports and docks.

4. Unutilised Capacity in Indian Industries : *The Economic Times*, 19, 20, 21, December, 1971

Table 3 . Man-days Lost (due to strikes and lockouts)

(In million)

Year	*Total*	*Central*	*State*
1969	19.05	1.69	17.36
1970	20.56	2.94	17.62
1971	16.55	1.93	14.62
1972	20.54	1.80	18.74
1973	17.97	2.78	15.19

From the above table it appears that labour situation was bad in 1972 as compared to that in 1973, while loss in capacity utilisation was more in 1973. The apparent contradiction is explained by the fact that in 1972 mandays lost were more in 'service' sector which has less effect on production and secondly, the situation was comparatively better in eastern region where most of the industrial units are concentrated. The situation in 1973 was quite the reverse. In this year disturbed industrial relations caused heavy loss to production at Durgapur Steel Plant and to some extent at Rourkela also. The underutilisation of capacity in rayon grade pulp was also due to a lock out in a major unit on account of labour trouble. Some of the other industries which suffered from labour troubles during the Fourth Plan are tea, vanaspati. wood and cork manufactures, rubber products and motor vehicles.

Lack of Demand

On the demand side, the most important factor affecting the capacity utilisation is lack of adequate demand for finished products. The fall in demand can occur either due to fall in purchasing power in the economy or emergence of some substitute in the market or a rise in the cost of production of the product. During the Fourth Plan, the pruchasing power of the economy declined sharply, thanks to cut in Government expenditure and strict credit controls imposed by the banking sector. Earlier, galloping inflation after Bangla Desh war had almost eroded the purchasing power of consumers. Industries like railway wagons, cement mill machinery, printing machinery were the victims of lack of demand. The impact of this factor was also noticeable in consumer durable goods industries.

The jute textiles industry also suffered due to a fall in demand in foreign markets because of competition from Bangla Desh. The demand for passenger cars declined because of a rise in petroleum prices.

There are some other constraints, which may not be of much importance for the industrial sector as a whole but quite significant for a paticular industry. For instance, conservatism on the part of management has affected the performance of public sector undertakings for long. Towards the end of the Fourth Plan period however, there was some improvement, resulting in better performance of public sector undertakings. So much so, in 1973 capital goods industries recorded a growth rate of 13.7 percent which was contributed mainly by public sector undertakings.

Lack of synchronisation in inter-industry demand affected the performance of metal and engineering industries. In 1971, there was excess capacity in wire ropes because of fall in demand of coal mining industry. Cement, sugar and coal industry suffered heavily at the hands of Government controls on prices that these industries almost got starved of investment funds. Then there is the case of mini steel plants where installed capacity rose at a fantastic rate, and just because the Government exempted those units from licencing and price controls. Installed capacity in these plants crossed 1.6 million tonnes in no time and even when these units were working at only 50 per cent capacity, 50 more units were expected to add another one million tonnes to the existing capacity. All these factors add together to explain the problem of underutilisation in Indian industries during the Fourth Plan.

Outlook for Fifth Plan

One of the objectives of the Fifth Plan is maximisation of output from existing capacity. The target for industrial output is set at 8.1 per cent annual growth rate and most of this increase is planned to be achieved through additional capacity. Obviously, the draft does not lay enough emphasis on full utilisation of capacity from the existing capacity. The targets of varous industries for capacity and production also show that the authorities do not consider the goal of full capacity utilisation possible during this period.

However, the outlook for the Fifth Plan period is satisfactory. It has been seen that during the Fourth Plan availability of power was a problem. The Fifth Plan target for power generation is at 33 million kw, which is all that the economy needs during this period. Though, the possibility of a shortfall cannot be ruled out, the Plan's emphasis on speedy implementation of new projects, proper maintenance and operation of power plants and regular supplies of coal to thermal plants aided by recent heavy monsoons is likely to keep any shortage away during this period.

For coal also, the position looks much comfortable. The new investments are sufficient to achieve the target of 135 million tonnes by 1978-79. The nationalisation of the coal industry has facilitated the formulation of an integrated production plan and other organisational reforms. The transportation aspect of coal supplies is also synchronised with the production plan.

In order to minimise the loss in capacity utilisation due to shortage of imported raw materials and components, necessary relaxations in the import policy have been incorporated. However, the situation regarding supplies of domestic raw materials (especially agricultural) remains uncertain. The bottlenecks in inter-industry demand and supply channels may also appear sometime during this period.

An encouraging change that has taken place on the industrial relations front is ban on strikes and lock-outs. A new sense of responsibility and discipline is also evident both among the labour and the management. The age-old habits like loitering, go-slow techniques, absenteism, etc., are disappearing. This obviously means that participation of labour alone is likely to reduce the loss in capacity utilisation quite significantly.

Then, the new policy directives given by the Government to the managements of public sector undertakings have shown good results during the last two years and this trend is likely to continue in the near future. The performance of public sector is very crucial for the economy as a whole and capital goods industries in particular. All these developments augur well for the performance of Indian industrial sector.

Maintenance for Capacity Utilisation

M. S. Mitra

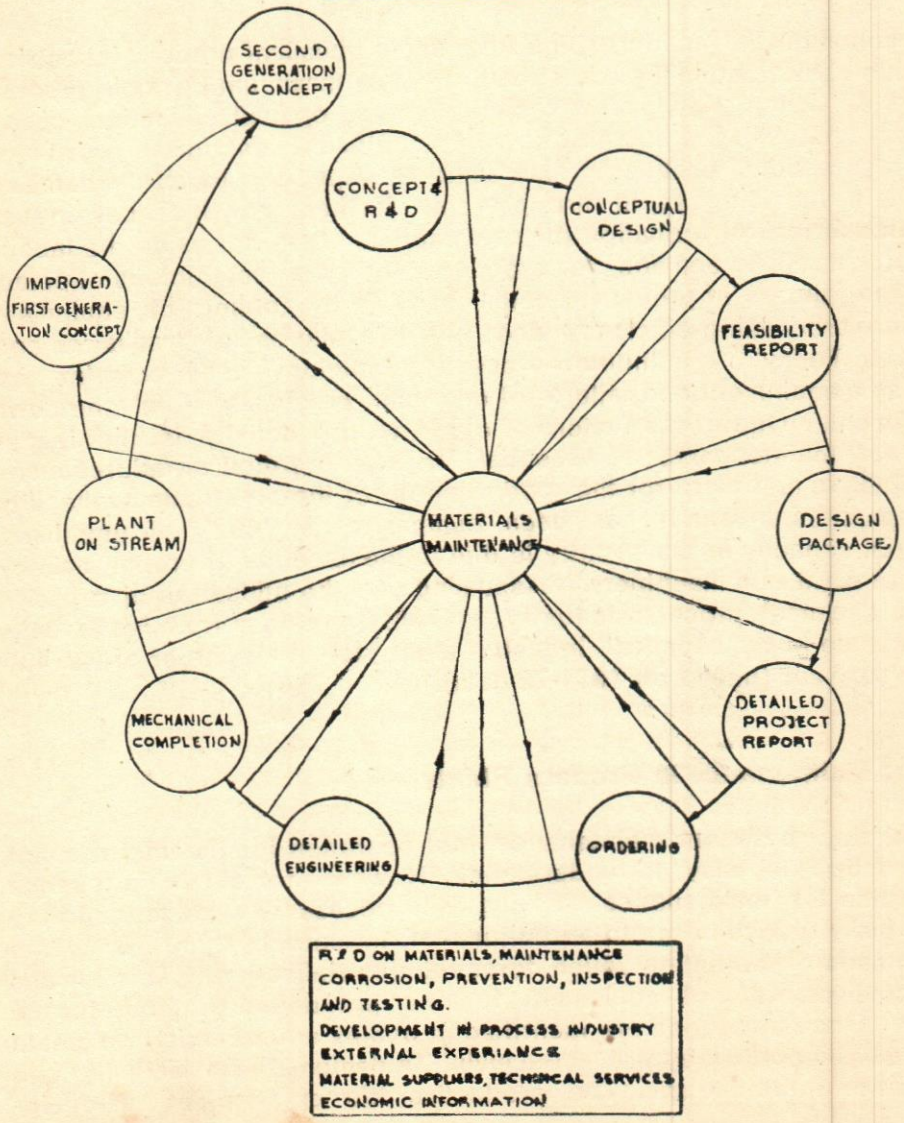
The economics of modern high investment chemical process industries depends basically on the on-stream time at maximum possible processing rate. Production below capacity or sub-optimal utilisation of the capacity has been the source of a very significant loss in the growth of our gross national product. This loss is especially harmful when one considers that this loss, in turn, prevents further growth of new industries due to lack of formation of new capital. Leaving aside the labour problems and the demand for products, the on-stream time is affected, (i) by the failures of process equipment, (ii) by fouling of equipment affecting processing efficiency and (iii) by failures of auxiliaries and utilities. Today's continuous process technology uses complex and expensive equipment and failure of one can precipitate total shutdown of the plant. One of the factors of our low productivity is the inadequacy of maintenance, so essential for the prevention of failures mentioned above and also for the optimisation of the on-stream availability of the process units. It has been estimated that 40% of unutilised industrial capacity in the country is due to the absence of proper maintenance of plant and machinery. Assuming that the utilisation of capacity in the chemical process industry is 70%, the loss from inadequate maintenance in the chemical industry alone is of the order of Rs. 400 crores per year (based on 1971-72 data).

Role of Maintenance in Process Plants

The relation between maintenance and operation for the improvement of production is easy to understand. However, for obtaining a sense of direction for maintenance activity, it is necessary to understand the role of maintenance in the total culture of industrialisation. It is the social needs of the nation which forces industrialisation. This means we create plants and equipment for the production of goods for the society. Once the goods are identified in quality and quantity, we create plants and equipment by first conceiving a design, then designing and implementing this set-up. The productive life of the plant and equip-

ment depends on maintenance and operation. This is the longest period in the life-cycle of plants and equipment (Fig. 1), and gives us

MATERIAL MAINTENANCE IN THE LIFE CYCLE OF CHEMICAL PROCESS PLANTS



the opportunity for gathering experience through increasing its productivity during its life time. During this period, we try out improvements in its design, operation and maintenance, and strive to attain optimum productivity with the changing technological, industrial and economic infrastructure. The experience we gather here is ploughed back into the concept, design and implementation of new plants and equipment. It is, therefore, very necessary that experience is documented and free inter-communication of this documented experience is made available amongst the functions of research and development, conceptual designers, and other implementing functions.

Expertise in Maintenance

The role of maintenance in this life-cycle of processing plants and equipment is very vital. Maintenance is a line function. Maintenance engineers/managers are extremely busy in day-to-day activities of keeping the plant in good health and running. To be effective in his line function, the maintenance manager needs to know of the latest developments on design, material inspection, cleaning, testing, corrosion control, material specification, tribology, value engineering, performance analysis (both failures and successes), industrial engineering, training of crafts, safety, personnel, supervision, management, spares and logistics, maintenance tools, maintenance organisation, accounting procedure and economic analysis in order to achieve optimum maintenance, besides being aware of the objectives of production/productivity level and the productive life of equipment. One can see that a maintenance engineer/manager cannot attain high level of expertise in all these branches. We generally find that the line maintenance managers are most effective when they develop expertise in personnel, supervision, management, spares and logistics, maintenance tools, maintenance organisation and have intimate knowledge of their plants, equipment, operation and men and are supported by expertise in the other areas. In the areas they develop expertise, they keep themselves updated by periodic re-training in the latest developments by the experts. The concept here is that the line maintenance manager is supported by engineering and technological specialist services.

Generally, the effectiveness of maintenance flows through the line fun-

ction. The need for integration of the expertise in various relevant areas and transfer of this through the line function is, therefore, most important. The development of expertise in the areas related to maintenance requires special consideration; and this can be achieved through interaction of the plant maintenance group and the specialists and participation of the specialists in gathering and documenting experience during the operating life of the plants and equipment. The experts have also, in turn, to interact with R & D, process designers, manufacturers of materials, plants and equipment and encourage development in these areas for present and future needs. It has been estimated that input of expertise consultancy directly accounts for 30% reduction of avoidable loss besides its contribution to the other stages in the life-cycle of process plants.

The complexity and sophistication of modern industry are today equal in both developed and developing countries since the developing countries are importing modern technology from the developed countries. A review of the large industries in developed countries shows the significant role that specialists play in the efficient maintenance, operation and development of modern industries. Experience has shown that because of complexity of modern industry specialists are necessary and with increasing complexity. more specialists will be required. An appreciation for the needs of such expertise in maintenance is still in a nascent stage in India.

The early industries were established in India as branches or subsidiaries of foreign companies with full control. Gradually more foreign collaboration companies with full controlling interest got established. The technical expertise services then became part of separate agreements. In the public sector such services were generally absent beyond a short initial period. The growth and progressive self-reliance thus created a critical vacuum in the sources from which expertise for maintenance could be provided. In order to fill in this void, expert consultancy organisations to serve cognate groups of manufacturing units or industries with common maintenance problems should be developed. The need for such an organisation to serve a number of similar industries and not to confine itself to a single industry lies in the fact that experience in a single industry can be narrow and, therefore, not conducive to the development of the kind of expertise envisaged. In fact, one of the main strengths of the specialist organisation is that the

experience gained in one industry is very often invaluable in solving the problems of the other. Another advantage of such centralised specialist organisation is the cross-fertilisation of ideas and concepts, which are essential for further improvement in maintenance and consequently, improving utilisation of capacity.

An important objective of the development of expertise indigenously is also to ensure that the system is optimum under indigenous conditions. While the basic principles should hold good anywhere, the optimum system will have to be developed in the context of the economic and industrial infrastructure. For example, the ratio of material cost to labour for maintenance in Western Europe is of the order of 35:65, but the ratio is reversed, i.e. 65:35 for similar plants in India. For optimising maintenance under Indian conditions, this fact would often encourage use of cheaper indigenous material requiring more frequent inspection and innovative maintenance.

It is amply clear that a perfect maintenance system, adequately backed up by expertise can pave the way for an uninterrupted on-stream working of plants and machinery. This would not only have an impact on increased production, but would enable effective utilisation of capacity of plants and machinery.

Managing Capacity in Indian Industries

Navin Chandra Joshi

Ever since the imposition of emergency in the country, a number of measures have been taken by the Government to release the industry from the straight jacket of industrial licensing and regulations. Surely, the emergency has dealt a blow to vested interests and there is no doubt that this is the most significant outcome resulting from it in the industrial field. At no other time has the Government machinery moved with so much speed and determination of dismantling to a large extent the cumbersome and ungainful large structure of procedures. The decks are now cleared for giving our industry a better scope and a great freedom for showing better results. But the problem today is as much of augmenting the existing production capacity as it is of utilising it to the maximum.

It is a matter of common knowledge that the Indian economy has suffered on account of underutilisation of capacity, particularly, in certain vital sectors of production. For instance, the generation of power per kilowatt of installed thermal power generating capacity in India is about 4,000 units per annum as against 7,000 units in developed countries. A step-up to say, 6,000 units per KW of installed capacity, as indeed is being aimed at, would mean nearly 24 billion additional units or about Rs. 240 crores worth of additional power. Similarly, an additional one million tonnes of steel production, which is well within the country's installed capacity, would be worth more than Rs. 150 crores. With better availability of power and other inputs, it should be possible to have an additional half a million tonnes of fertilizers worth about Rs. 125 crores and an additional Rs. 250 crores worth of heavy engineering equipment from existing capacities. Thus, in these sectors alone, additional output of the total value of well over Rs. 750 crores can be had from the investments already made, provided the problem of underutilisatian of capacity is tackled resolutely.

Utilisation of Capacity

Capacity utilisation as an indicator of efficient running of an enterprise,

is of vital significance to the national economy as a whole. Indeed, the accelerated growth depends both on sustained creation of capacity and on optimum use of machinery and equipment already installed. There has been a slow pace in recent years in the creation of new capacity as also in the actual utilisation of available capacity in many industries. Therefore, apart from measures to accelerate capacity utilisation, a series of concerted devices are equally necessary to create additional capacity where there has been expeditious clearances of industrial licenses.

Table 1 gives the position regarding capacity utilisation in selected industries in respect of two different years for comparison.

Table 1 : Capacity Utilisation in Selected Industries

(In percent)

Industry-group	*Weight*	*Average (weighted)*		
		1968-69	*1973-74*	*Change*
Basic Industries	6,070	73	63	—10
Capital Goods Industries	4,046	54	59	+ 5
Intermediate Goods Industries	7,687	83	75	— 8
Consumer Goods Industries	7,678	95	77	—18
All Selected Industries	25,481	78	70	— 8

Source : Industrial Development Bank of India, Annual Report, 1973-74.

In the above table, data relating to 40 major industries are included. It would be seen that capacity utilisation in these industries declined from 78 per cent in 1968-69 to 70 per cent in 1973-74. The decline was higher in consumer goods industries, followed by basic industries and intermediate goods industries. It would be instructive to relate actual capacity utilisation to the growth in industrial production during the period of the Fourth Five-Year Plan, as seen in table 2.

Table 2 : Growth in Industrial Production During Fourth Plan

(in per cent)

Industry group	*1969-70*	*1970-71*	*1971-72*	*1972-73*	*1973-74*	*Compound growth rate*	*Target growth rate*
Basic Industries	9.4	3.4	6.9	7.3	—2.4	4.9	9.9
Capital Goods Industries	1.4	6.0	0,4	10.5	11.9	5.9	17.1
intermediate Goods Industries	3.8	1.2	3.6	4.3	—1.1	2.3	5.8
Consumer Goods Industries	10.2	4.5	5.2	1.4	—2.9	3.6	5.3
All Industries	7.4	3.0	3.3	5.3	0.5	3.9	8.10

Source : Industrial Development Bank of India Annual Report, 1973-74.

It is obvious that the actual growth during the Fourth Plan period was 3.9 per cent against a target growth rate of 8.10 per cent. In the last year of the Plan (1973-74), growth in industrial production was almost stagnant. From the above two tables, we see that by 1973-74 capacity utilisation in consumer goods industries had registered the maximum decline and this had, therefore, its adverse impact on the output of consumer goods which fell by 2.9 per cent in 1973-74 over the previous year. Similarly, in basic industries, the decline in capacity utilisation also affected its output and the same trend is evident in the case of intermediate goods industry. These two tables establish a definite positive correlationship between decline in the actual use of capacity and output. The worst part of the decline in capacity utilisation is that it was much higher in consumer goods industries. Obviously, it was then the common man who suffered most due to the underutilisation of capacity in the manufacturing sector. And since the output of consumer goods is overwhelmingly in the private sector of the economy, there is every reason to believe that either it was deliberate or otherwise pressing constraints of mismanagement, strikes and lockouts bore the major brunt of the causal factors.

Causes of Underutilisation of Capacity

Amongst the reasons generally noted for underutilisation of capacity are power and raw material shortage, credit squeeze, inadequacy of demand, shortage of coal, transport difficulties, labour troubles and so on. However, there are many other factors also which, though equally important, are seldom accounted for or adequately taken note of as of any consequence in an assessment for underutilisation. It is, therefore, necessary that in dealing with this problem, these factors should be carefully reckoned with. For instance, there are specific Inputs falling within the area of management of individual units, which if administered properly, can improve capacity utilisation. In the first place, the greatest importance should be attached to proper utilisation of human resources, be it managerial, supervisory or at the workers' level. We must remember that after all it is men who eventually deliver the goods and to do so they must be provided with adequate motivation and a sense of participation. And it is this input whose development requires longest time-cycles. Further, generally the ills of a manufacturing unit are attributed to industrial disharmony and labour problems. However, it has been found

in a majority of cases that there is a close relationship between the state of industrial relations and the quality and nature of top management. The top management has often tended to regard itself as an exclusive preserve far above in the hierarchical ladder and this has dampened the enthusiasm of middle management. Merit and Competence at the middle level of managers are seldom rewarded.

Likewise, if the company made profits, these were often skimmed off into more lucrative trades or other business and lines of manufacture, which therefore, deprived the plant of the means to modernize and replace worn-out equipment. In the public sector too, the selection of chief executives and top managers in the initial stages left much to be desired. Many of those selected to the top echelons of management regarded their stay in the public sector as a transitory change which obviously meant that they were neither fully equipped to start with nor were they remaining long enough in the public sector to acquire the necessary professional skill and to identify themselves with the well-being of the undertaking to which they were assigned. There has lately been some progress towards professionalisation in management, career planning and selection of top men by virtue of their abilities and not label. The progress has, however, not been fast enough or adequate. Management is a subject by itself and its tenets do suggest measures to increase production and productivity with better organisation, co-ordination, control mechanism, planning and so on. Every production unit of an organisation having its own set of problems and challenges needs to have the right persons with appropriate professional competence.

There are many instances where plants were allowed to go obsolete because the management seemed to think that as long as the machine was running, no attention be given to the prolongation of its life and the need for keeping pace with modern developments and technology. It was hardly realised that plant is like an organism which must be kept in good repair. There should be a regular programme for rehabilitation and modernisation of plant and equipment in a systematic and well-planned manner. It was precisely because this was lacking that many units in the private sector which at one time were doing well and were making good profits, became sick one after the other and had to be taken over by the Government and rehabilitated. Linked with this is, therefore, the question of proper maintenance. Very often the practice still prevalent is to take up maintenance of production machinery and

equipment only when it breaks down. If a systematic schedule of preventive maintenance is worked out and followed, valuable machine-hours can be saved, resulting in increased production. A higher rate of capacity utilisation is not the ultimate end. What matters more is the higher rate of output than before. If this could be achieved with the same previous rate of utilisation of installed capacity, surely it is as desirable as it would be a good pointer towards setting the organisation's managerial house in order.

Although it is difficult to quantify the extent to which managerial deficiencies impinge on productivity and capacity utilisation, a look at the measures taken by the Government for improving performance shows that most of them fall in the sphere of managerial actions. It means that problem-solving measures were located within the organisation by improving managerial and operational performance. The conclusion that emerges is that an improvement in capacity utilisation can be brought about to a large extent by measures which are other than strictly 'technical' in the sense that more than machines, it is the human element which plays a decisive role.

Capacity Determination in Coal Mining Industry

Rakesh Kumar

Mining is one of the oldest occupations. Before we discovered the use of wheels and pulleys the various ores were extracted manually. The most common tool used for mining was a pick, and thus came to be known as pick mining. This type of mining is still prevalant in many parts of our country.

Switching over from manual operations to machanisation, the mining industry has undergone a revolution. Some of the western countries are now practising automation in their mines. We are still in a transition stage. The government has taken over a number of coal mines during the last three years, and is having an ambitious programme of machanisation, as the king coal is back again. This huge investment proposed by the government has to be tried for its economic viability. In other words, additional capacity created has to be weighed against the investment. Therefore, determination of the capacity of the existing installations has become necessary. The purpose of this paper is to provide an approach for the determination of capacity in a coal mine.

Approach

The capacity of a coal mine is the ability with which various resources of men, materials and machines are deployed for extracting coal deposits. There are three stages involved in extracting coal. They are :

(a) Removal of coal from face of the mine;

(b) Horizontal transportation of coal ;

(c) Vertical transportation of coal ;

These three stages can be regarded as three links of a chain and obviously the strength of the chain would be determined by the strength of the weakest link. This gives an idea as to how one can assess the

capacity of a coal mine. Before determining the capacity of the mine as a whole, an individual assessment of capacity of face, haulage and shaft/incline is essential.

Determination of face capacity

It is the amount of coal available for extraction at any face. This availability will depend mainly on a) size of the face, b) location of the face, c) degree of mechanisation and d) the ventilation at the face.

To determine the face capacity, different approaches have to be adopted in cases where faces are being exploited manually and in cases where machanisation has been introduced. The approach to be used in two such cases is discussed below.

(a) *Pick Mining* : Face capacity in the case of pick mining can be established by carrying out work-sampling study on a group of miners working at any face. Generally, standards established and used in westetn countries lie between 1.5 tonnes to 2.0 tonnes per miner per shift of 8 hours. In India, 0·8 tonne to 1·0 tonne per miner can be expected. It must be observed, that in the case of pick mining, ventilation is an important factor and effects the capacity of miners. Therefore, standards need to be altered depending upon the ventilation conditions at the place of work.

Maching Mining : This assumes uses of solid blasting methods and cutting machines and drills. Cutting machines and drills are generally common for a district containing a number of faces. Here, the capacity depends upon the number of cuts a machine can take in one shift, number of faces available, time taken to remove the blasted coal and the amount and type of explosive used. In order to determine the face capacity, it would be worthwhile to study the cycle of operations which constitutes : a) cutting by machine, b) drilling of holes, c) charging with explosives, d) blasting and clearing of smoke, e) clearing the blasted coal.

Each operation of the cycle takes time and should be measured with the help of a stop watch. The sum of the time taken by all the operations gives the cycle time. Number of cycles should be studied to arrive at reasonably accurate results.

$$\text{Thus, face capacity} = \text{Tonnage blasted per cycle} \times \frac{\text{Time available per shift.}}{\text{Time per cycle}}$$

As the cutting machine, drill etc. are common for a district having a number of faces, it is easy to compute the face capacity for a district. Based on the studies carried out in some of the coal mines, broad standards are given below as guidelines :

i) With one coal cutting machine and one drill in a district having three heading developments or 5 faces, 80-100 tonnes can be expected per shift.

ii) With one coal cutting machine and two drills in a district having five headings development or seven faces, 100-120 tonnes can be expected per shift.

The guidelines given above correspond to a standardgallery of 14ft. × 8ft, and gradient upto 1/6. For steeper gradient and smaller sizes of the galleries figures have to be adjusted correspondingly.

Determination of Haulage Capacity

Haulage capacity is defined as the capacity of the equipment used for transportation of coal from the face to the pit in a mine. A set of haulages are generally common to a district. Therefore, haulage capacity for a district should be computed.

Haulage capacity is a product of number of trips made per shift and coal tonnage hauled per trip.

$$\text{Number of trips made per shift} = \frac{\text{Time available per shift}}{\text{Time per trip}}$$

Time per trip can be measured by studying a number of cycles with the help of a stop watch. Time per trip can also be computed arithmetically using the formula :

$$T = \frac{2L}{Va} + \frac{4l}{Vc} + \frac{4Z \times Ic}{Vc} + to$$

where T = Time spent in a round trip ;

L = Length of straight track of haulage ;

l = Length of curves ;

lc = Length of car ;

Va = Average speed of train ;

Vc = Average speed of train at curves ;

to = Time spent for attaching and detaching the rope at the terminals; and

Z = Number of cars per train.

Tonnage hauled per trip = Number of cars per trip × amount of coal per car.

In case, there are a number of haulages working in series in a district, the lowest haulage capacity should be taken as haulage capacity of that district.

Determination of Shaft/Incline Capacity

Shaft/Incline capacity is the capacity of the equipment deployed for transportation of coal from the pit to the surface of mine. Capacity of a shaft is simplest to determine of all the three capacities. It can be expressed as :

$$\text{Shaft capacity} = \frac{\text{Load carried per trip} \times \text{Available Hours per shift}}{\text{Time taken per trip}}$$

Load carried per trip can be determined from the capacity of the equipment.

$$\text{Time taken per trip} = \frac{\text{Distance}}{\text{Speed}}$$

Determination of Mine Capacity

Once, the face capacity, the haulage capacity and shaft/incline capacity

are determined separately, the capacity of the mine is determined by the minimum of the three capacities referred above. For instance, suppose 100 tonnes of coal is extracted from the face (face capacity) in one shift of 8 hours. The haulage capacity is 80 tonnes during the same shift period. In such a case, even if the shaft/incline capacity is 120 tonnes, coal brought to the surface of the mine would be 80 tonnes per shift. Thus, the capacity of the mine could to taken as 80 tonnes per shift.

Criteria for Additional Investment

A study of 80 coal mines has revealed that the bottleneck capacities are in the following older :

i) Face capcity—in 70% cases;

ii) Haulage capacity—in 20% cases, and

iii) Shaft/Incline capacity—in 10% cases

Thus, it makes quite clear that if any additional investment is to be made, It should be first in increasing face capacity through mechanisation and by providing better ventilations and secondly, by enhancing haulage capacity, so that the existing shaft capacity can be effectively utilised. This can be a short-term objective.

If, on the other hand, large investments have to be done, it can be taken as a long-term objective, where a systematic planning of higher capacities of face, haulage and shaft can be made. Better tools, equipments and methods can also be used not only for enhancing production, but also for improving prductivity.

Wages and Inflation

Mahesh Chandra

It has aptly been said that 'inflation has nothing to smile about'. It may result in abnormal profits for some sections of community, but largely, penalises all those persons who are unable to adjust their incomes to compensate for higher living costs. Rising unemployment, sinking wages, sharp rise in money supply, steep rise in prices and low level of production and productivity are some of the manifcstations of spiralling inflation. The operation of inflationary tendencies can be somewhat justified on political grounds, but hard to digest it on social plane. Though inflation helps in maintaining the employment level or even increasing it but it is done at the cost of higher prices. From economic standpoint also, inflation is not desirable as it does not help the national income to grow at a faster pace. It, in fact, makes people spendthrift rather than induce them to save and invest in the face of declining purchasing power of money. Other economic drawbacks can be damage to the balance of payment; distorted price structure leading to a sub-optimal distribution of investments; and the survival of sub-marginal undertakings.

A certain extent of inflation in any developing economy and resultant price rise is inevitable and, therefore, should not cause worry. Even in countries where deficit financing and inflation are not disproportionately out of tune with the increase in the national income, prices still rise although such increases are usually modest and tolerable. However, in our country, inflation has assumed serious proportions due to the recent price spiral which has touched an all-time high. The wholesale price index increased by 4.8 percent during 1971-72 over the previous year's level, whereas the increase in wholesale price index in 1972-73 over 1971-72 was 9.9 percent.[1]

Causes of Inflation

The origin of ever-increasing inflation in India can be attributed to some serious unavoidable events which took place. The political turmoil in East Pakistan, (now Bangladesh) followed by Indo-Pakistan war in 1971,

1. *Commerce* 18th, Aug. 1975 p 5 (Supplement)

rendered lakhs of people in East Pakistan homeless and find shelter in India. This expenditure had a telling effect on Indian economy. Besides this, floods in Bengal and later severe droughts in large parts of India put the whole economy out of gear. Devaluation of Rupee, slackening of exports and sinking of the value of Rupee in internal market acted as catalyst to enhance inflation. The heavy investment of capital in unproductive channels had made the position of our economy further difficult. Besides, heavy deficit financing, fiscal policies, operations of a parallel black money economy were some of the factors giving boost to inflationary tendencies. Of late, the oil crisis has added more miseries. The soaring prices of crude oil alone were sufficient to necessitate re-allocation of our planned expenditure.

The industrial production started declining. The factors responsible were acute shortage of raw materials, resulting in increase in prices transport bottlenecks, shortage of power, and widespread industrial unrest. In the field of agriculture the per-capita availability of foodgrains continues to be less than the level reached in 1970-71. This explains partially, the widespread shortages of agricultural products and aggravated further, because of the malfunctioning of the public distribution system. A plethora of controls and regulations, coupled with the pricing policy of the Government in respect of essential items of daily use, as well as the arbitrary and uncalled-for price hikes of various commodities by the traders have landed the common man in deep waters. Besides, the imbalances created in the economies of developed countries, due to their economic difficulties coupled with their monetary and trade policies have also affected the run of prices:

Demand for Higher wages

The demand for higher pay by the wage earners or by their representatives is not unwarranted. However, in most of the cases, the managements themselves grant wage increase. A brief discussion on the various types of demands for higher wages is given in subsequent paras.

(i) *Additional Labour :* As prices increase, more profits occurred. More profits result in more investment, which tends to more employment. Thus demand for additional labour is likely to trigger off wage increases.

(ii) *Inter-Industry and inter-sectoral wage differentials :* A wage increase in a given industry/sector, is bound to spread to other industries/ sectors of the economy. This gradually results in the growing demands for wage increase in all the industries on the grounds of parity. Such demands are not confined to the organised sector of industries alone where workers have requisite bargaining strength, but even the workers in unorganised sector of industries demand wage increase.

(iii) *Expanding trade union activities :* The growing trade union movement in the country and dynamic leadership has made the wage earners more vocal and their protests and demands carry weight. Strikes, lockouts, go-slow tactics, etc. are some of the strategic weapons in the hands of labour.

(iv) *To protect purchasing power of wage earners :* There is an irresistible demand on the part of workers/unions for higher wages, so as to guard against the adverse effects of rising prices. Such demands are put forth with the object of securing better purchasing power, as this is regarded as workers' right to a higher share of what the nation produces in a stable economy. In other words, it is just demand of re-distribution of national wealth in favour of wage earners.

In order to provide protection to the real wages of workers against price rise, the system of paying dearness allowance[2] in consonance with the rise and fall of consumer price index numbers has been widely adopted in the organised and some of the unorganised sectors. In some cases, protection is also provided by making suitable adjustments in the consolidated or basic wages of the workers, as the case may be. Though the system proved useful in providing some financial cushion to wage earners at times when consumer goods were scarce, this process itself leads to raise the cost of living still further. The system also suffers from the following :

a) Unlike prices, wages are not permitted to rise to their market level. With wages not usually rising as quickly as the cost of

2. Dearness allowance is a device to protect, to a greater or lesser extent, the real income of wage earners and salaried employees from the effects of rise in prices.—Das Commission.

living, the purchasing power of the workers continues to erode;

b) Time-lag between the rise in prices and the collection and publication of the cost of living indices;

c) Dearness allowance system is a temporary expedient and it does not provide answer to the continuous declining wages due to price rise.[3]

d) The coverage of the system is not complete. The workers in the organised sector by virtue of their united force, are also to receive more protection against price rise in the form of periodic payment of dearness allowance or wage revisions. In contrast, the workers who were granted protection by minimum wage legislation seem to have fared even worse. In their case, not only the wage level is exceptionally low, but the implementation of the wage rates so fixed is also ineffective. It is due to this limitation that only a section of the working class could derive some advantage and improve their purchasing power. This, in turn, meant transfer of hardships to groups not protected by any labour laws or those who are not in a position to secure such gains through collective bargaing.

Is Wage Increase the Real Cause of Inflation ?

The determination of wages is one of the essential functions of economic planning. The structure, in turn, affects the efficiency of workers and constitutes an important factor relating to price calculation. In short, wage structure provides the necessary basis for price structure in a planned economy. Thus, prices always include cost of production and normal profits and the cost of production includes the cost of labour. This leads to the belief that if there is wage rise there will be a corresponding increase in the prices of the products manufactured by the concerned undertaking. The rise in prices, in turn, will boost up the inflationary forces. Once the price of any commodity goes up, it has a tendency not to return to the original base, but settles somewhere at a higher level. In this process of wage-price spiral the capitalist and wage earners win and lose alternately. Thus inflation goes on satisfying their demands in turn. In actual practice, it may be seen that it is

3. It the real value of salaries and wages is eroded, the proper remedy would be the revision of pay scales. Dearness Allowance cannot be utilised for that purpose : Gajendragadkar Commission (1967).

due to rise in prices which generates higher wage demand and, not *vice-versa*.

The assumption that rise in wages will tend to raise prices may be true to some extent in the case of more advanced countries, where the wage bill constitutes a significant part of the national income. The position in India is just the reverse, where the wage bill as a part of value added by manufactures is insignificant in proportion to the total wage bill. It is, therefore, incapable of affecting the price level to any visible extent. Logically, it is incorrect to say that the rise in wage will lead to rise in prices and, therefore, wage increase cannot be held responsible for rise in prices. The National Commission on Labour was on sound grounds when it observed (Page 229, para 15.35) :

> "This last relationship or the feed-back mechanism is, however, often exaggerated. Firstly, the increased purchasing power in the hands of the workers on account of compensatory payments for rise in cost of living forms a small part of the overall increase in purchasing power. Secondly, the elasticity of compensatory payments to changes in cost of living is generally less than unity so that the feed-back must taper off. Money wage stability, though important for price stability, is seldom a necessary, much less a sufficient condition for it. On the other hand, holding of the price line, particularly of the cost of living, is an adequate condition for preventing increases in money wage payments that are not related to increases in productivity. This alone can prevent a fall in real wages. Hence, policies that hold down living costs should form an integral part of wage policy. A successful implementation of such policies would not only restrain increases in dearness allowances and compensatory wage payments, but it would also lead to the stabilisation of prices of goods whose costs are sensitive to wages".

Wage Freeze

Quite often an impression is created that it is the soaring demands for an increase in wages, without a corresponding increase in productivity, that is responsible for inflation. As a remedy it is advocated that there should be an everlasting wage freeze or at least until productivity increases. It is a common knowledge that productivity is almost a sole management function and on it workers have hardly any control. Labour is one element in the process of production. Other factors like capital, plant and machinery, availability of raw material and power, technical

know-how, etc., are other important variables affecting production. To blame labour squarely without going into proper investigations for decline in the production will not at all be reasonable. On the contrary, we have evidence to quote that while general index of industrial production in manufacturing industries went up by more than 40 percent, during 1961-67, the real average wages of workers actually declined by 9 percent. Further, during 1961-71 the index for industrial production rose by about 65 percent, but the real average wages advanced by only 2 percent. At present, large mass of workers are receiving very low wages and as between the similar occupations in the same industry, there are inequalities in wage payments. In such a situation, any step towards wage freeze will simply be a hazardous and a retrogative step. To think of wage freeze alone, while allowing profits and prices to rise freely will also not be fair enough. Moreover, any curbs on wages will prove ineffective as it will not provide any monetary incentive to workers for higher standard of performance. A zonal seminar on wage policy organised by the Indian Institute of Workers' Education, Bombay in December 1973, expressed almost identical view:

> "Wage freeze is no remedy for inflation. In the present context of economy, factors like monopoly, restrictive practices, deficit financing and unproductive expenditure have more influence on prices than wages".

A close perusal of undermentioned statistics (Table I) relating to index numbers of money earnings and real earnings of workers in manufacturing industries during 1962-71 will show that while real earnings of workers during 1962 and 1963 increased by 3 points, it went on declining from 1964 to 1968. This was mainly on account of continuous and steep rise in consumer price index numbers. The position, however, registered a slight improvement during 1969 to 1971. This may lead to the conclusion that whatever increases were granted to workers in the form of dearness allowance, wage revisions, bonus payments, etc., during 1964-68 have been more than offset by the rise in prices. The slight rise which accrued to industrial workers in their real earnings during 1969-71 is of no consolation as it is too negligible to leave any reserve with the workers to withstand the wage freeze, even temporarily, in the face of rising prices. Truly speaking, the workers in the manufacturing sector of economy have not yet been able to recover from the losses suffered by them in their real earnings during the period 1964-68. If such workers are intended to be brought within the ambit

of wage freeze, it will be against all canons of social and economic justice. In fact, the very idea of wage freeze will tend to create a psychological atmosphere of horror in the industrial population. The remedy may prove worse than the disease itself.

Table I : Index Numbers of Money Earnings and Real Earnings of Employees drawing less than Rs. 400/- per month in the Manufacturing Sector of industries under Payment of Wages Act, 1936, during 1962-71.

Year	*Index No. of money earnings*	*All India C.P.I. Nos. (base shifted to 1961=100)*	*Index No. of Real Earnings*
1962	106	103	103
1963	109	106	103
1964	114	121	94
1965	128	132	97
1966	139	146	95
1967	151	166	91
1968	160	171	94
1969	170	169	101
1970	180	178	101
1971	187(P)	183	102(P)

P—Provisional

Source : Indian Labour Statistics, 1974

Wages and Productivity

Economic growth of an economy depends mainly on wages and productivity. In working out a relationship between wages and productivity, various problems emerge such as the measurement of productivity, sharing of benifits accruing therefrom, consequences of linking wages with productivity in individual industry, inter-industry and inter-sectoral wage structure, etc. However, this system of linking wages with productivity is in vogue wherever workers are paid wages on piece-rate basis. The production bonus and incentive bonus scheme in certain industries

are other manifestations of the above concept. However, there is a real need to modify suitably the price-rates in the light of the latest time and motion studies, wherever not already undertaken. But the concept of linking wages with productivity is resisted by workers. According to them :

> "Wages are not dependent upon productivity of labour and cannot be linked with it. The slogan of linking wages with productivity under conditions of capitalistic relations is another attempt to keep wages low, while increasing workload and profits. The presence of large army of unemployed is used to depress the wage level. In Australia and Japan, scientific and technological advance is used to increase the value added to manufacture which, while reducing the relative share of workers as wages, multiplies the volume of profits".[4]

Undoubtedly, if workers are not paid the remuneration due to them, production and productivity would hardly increase and consequently, the national income. Therefore it may be desirable to link wages with productivity and prices, especialiy in the areas where it is operationally feasible and where workers and employers have no objection to the linking.

Anti-Inflationary Measures

From the above, it is clear that unless we succeed in establishing a close relationship between wages, prices and production there cannot be a possibility to contain inflation. A well coordinated effort on the part of the Government is called for, to reduce non-developmental expenditure, to augment production and to bring about an equitable distribution of goods produced. The new climate emerging out of recent imposition of emergency has been successful in containing inflation. However, a few other measures are listed below which can enable us to cut inflation to size :

(i) Growth rates, savings and investment of financial resources and balance of payments should be in consistent relationship. Savings rate, in particular, must be stepped up by introducing drastic restraints on essential consumption in public and private spheres as also by providing

4. Asian Trade Union Seminar, April 24th to 28th 1972, held at New Delhi

attractive returns to the depositors; investments need be made only on productive projects on priority basis.

(ii) Fiscal and trade policies of the Government be critically examined and adjustments made to revive our ailing economy, particularly, those concerning the balance of payments. This will help build the most needed reserve. Deficit financing should be resorted to the barest minimum and that too under most pressing circumstances.

(iii) Complete austerity must be practised in Government expenditure, money supply may be restricted to the extent desirable and measures curbing consumption be given priority.

(iv) Progress should be made in the fields of industrial, mining and agricultural production. Agricultural production be given top priority in order to minimise shortages and scarcitiesof essential food items, Special significance be attached to the proper development of sectors like coal, power and irrigation.

(v) An efficient procurement and public distribution machinery is the primary condition. The prices can be kept under control by increased investments in these sectors to generate activity in all branches of the economy. This will eliminate drags in any sector and thereby avoid any lop-sided development.

(vi) Steps to arrange resource mobilisation must be initiated forthwith on war footing, by checking the outflow of foreign investments ; credit restraints ; and by imposing additional surcharge on Central and State taxes, etc.

State Governments must mobilise their own resources and create additional resources to the optimum limit to meet their plan and non-plan requirements in order to avoid dependence on Central Government.

(vii) Government must unfold a concrete pian to stabilise the price of essential commodities and goods. Essential items may be made available to the common man through a net-work of co-oprative stores, fair price shops, etc. and efforts must be made to narrow down the big gap between the controlled and market prices. A Consumer Prices Commission may be set up in near future to ensure regulation of prices of

consumer goods on a country-wide basis keeping in view the interest of consumers on the one hand and that of manufacturers on other. The setting up of commission/committees will not serve the purpose, unless the majority and unanimous recommendations are implemented rigidly and speedily.

(viii) Our main object should be the stabilization of price level. Price rise should be restricted to the minimum number of areas where they are unavoidable. Since food prices are the dominant element in the consumption basket, these should be kept under stricter observation and control. Monopolistic control over costs and prices by the Corporations must be checked. There appears to be an urgent need for clear-cut pricing policy.

(ix) Country must generate more productive employment opportunities in non-wage paid employments such as agricultural services, commerce and trade.

(x) Inflation is an international problem and it must be tackled through closer co-operation and understanding between comity of nations. The international economic conduct should solely be guided by principles of justice and equity. The international bodies like World Bank, International Development Association, Aid-India Consortium and Food and Agricultural Organisation, etc. can play a significant role in this direction.

(xi) An integrated wages, salaries and incomes policy need be evolved for the guidance of Public and Private Sectors. This is necessary to reduce the share of non-wage earner, which does not have functional justification and to increase the share of a State in surplus. The formulation of such a policy will require a great deal of caution and restraint as that will provide a basis for the social and economic advancement of workers and community in general. The said policy may be evolved by taking an over-all view of all social groups in relation to the total performance of economy, as a whole, at one point of time. The success of such a policy will largely depend on price stability, hence this factor may be given special consideration.

(xii) Adoption of progressive and dynamic wage policy ensuring rising real wages to workers on the one hand and higher economic growth through increased productivity in order to sustain that wage level on the other appears to be an essential factor to be developed.

(a) A bear minimum wage based on the needs of worker and his family irrespective of any other consideration must be ensured.

(b) Wage policy must generate higher savings and stabilise economy by favouring non-wage incentives to workers in the form of better working and living conditions, reduced working hours and other fringe benefits.

(c) Wage policy should be formulated in close relationship with the pricing policy of the country. If the wage factor is not matched by a proportionate increase in productivity and production, the very system will not be able to adjust itself to the growing demands of labour.

(d) A duty based trade union, instead of agitational approach, is a primary condition. The working class must come forward to help create a new harmony in industry, particularly in public undertakings. Primary responsibility devolves on them to ensure that productivity and production are maintained at the highest possible tempo. In the sphere of industrial relations, the dispute settlement procedure has to be streamlined.

Of late, certain measures* have been announced by the Government : (i) providing for part impounding of further increases in wages and dearness allowance, (ii) imposing a ceiling on dividends and (iii) compulsory deposits scheme for higher income groups as part of Government's attack to curb inflation. The ordinances come into force immediately and extend to the whole of the country. In the wake of emergency the government has met with success to solve the problem of inflation, but even this has to be implemented more effectively.

*(a) The Companies (Temporary Restrictions on Dividends) Ordinance, 1974.

(b) The Additional Emoluments (Compulsory Deposit, Ordinance, 1974—Section 14 empowers Government to exempt establishments and categories of employees who are lowest paid from the purview of the ordinance.

The amounts of additional wages and 50 percent of additional dearness allowance compulsorily deposited will be impounded in special fund with the Reserve Bank of India and no part of it will be available to any employer or even to the State or Central Government. The deposits in these funds will carry a rate of interest $2\frac{1}{2}$ percent higher than the maximum bank deposit rate which is now $8\frac{1}{2}$ percent per annum.

(c) Compulsory Deposit Scheme for higher income groups under the scheme, the income tax payers with aggregate annual income exceeding Rs. 15,000 will be required to make compulsory deposits for two years 1974-75 and 1975-76. The taxpayers will be required to deposit 4 percent of their aggregate income (non-agricultural and agricultural) upto Rs. 25,000/-, 6 percent of the aggregate income in the slab Rs. 25,000/- to Rs. 70,000/- and 8 percent of the balance. The compulsory deposit will carry simple interest at the rate of 8.5 percent per annum.

Operations Research in Ship-building

N. V. Viswanathan

Major contribution of Operations Research is the concept of a model that summarises in few numbers many of the factors involved in a complex choice. When problems arise many considerations are involved and a device for summarising and condensing them is helpful. These considerations help to determine alternative solutions to the particular problem identified by study. It is necessary that different results for alternative solutions are to be compared, in order that a firm choice can be made from them and for this purpose only all factors must be considered.

Broadly speaking, only three factors are involved in this particular approach of Operation Research:

(i) Problems are stated by use of mathematical symbols which provide a form of expression that is concise and easy to understand.

(ii) A cardinal rule of operations research is—construct a model. The use of physical models is, not uncommon in industry.

(iii) The quantitative measurement of several independent and dependent variables.

The problem examined in this study is *'Construction of Ships on Berths'*. This gives scope to determine optimum number of berths to be used in a particular shipyard. The construction of a ship on berths is assembling of steel panels to form the hull, and the first panel to be erected starting the process is the keel or bottom panels. The construction of Hull proceeds upto the launching stage. Launching is the slipping or transfer of the completed hull from the berth (slipway) into the waterway.

A Reconstruction/Development Programme at Hindustan Shipyard has been under way from 1968 onwards. The following question arose

regarding the number of berths :

> "Whether to increase the number of berths, or to decrease them. What should be the optimum number and considerations to determine this number".

Considerations

The considerations to be studied for construction on berths are :

(i) Construction time on berth
(ii) Supervision
(iii) Work-in-progress (Steel and Capital locked up)
(iv) Flexibility of work
(v) Event completion
(vi) Vacancy of berth
(vii) Lead time for procurement of steel

This study helps to determine the number of berths and these seven considerations are each summarised in the form of equations. The symbols used are :

x = Weight of ship hull in tonnes

b = Production—Average erection tonnage per month

y = Number of berths

c = Construction time

a = Number of months between launchings

Construction Time on Berth : The construction time on berths indicates the duration from laying keel panel up to launching. The main work during this period is the erection of hull structure, normally indicated as tonnes of erected steel. The monthly production on building-berths is also indicated in tonnes of steel erected. Normally only one ship is built on a berth, thereby making full use the berth dimensions.

Hence, the production per ship per month $= \frac{b}{y}$

Construction time, say C_1 $= x \div \frac{b}{y}$

or C_1 $= \frac{xy}{b}$

If a berth is removed say $(y-1)$
then, construction time say C_2

$$C_1 > C_2 \quad = \frac{x\,(y-1)}{b}$$

Hence, on reduction of berth numbers the actual construction time is reduced.

Supervision : With fewer berths, supervision can be more effective since the working area for supervision is reduced.

Work-in-Progress : During construction the steel erected is carried over from one year to another, as the various hulls are in different stages of erection. Work-in-progress here is considered as taking the ship to the launching stage. Identical conditions of weight of ship, number of launchings per year and the time between launchings are considered for y berths and (y—1) berths in order to make comparison.

No. of launchings per year $= 12/a$

To find out the locked-up steel, consider how much steel is locked up on the berth where the next launching takes place.

Assume the next launching will take place 'a' month after the preceding launching.

or in the berth where (construction time from K to L-a) months the erection has been going on.

Hence, steel locked up on that berth will be :

$$= (\text{construction time} - a).\ \frac{b}{y} \qquad (1)$$

Construction time from above $= \frac{xy}{b}$ ..... (2)

Substituting (2) in (1) : $\left(\frac{xy}{b} - a\right).\frac{b}{y}$ is the steel locked up. (3)

Consider $\frac{xy}{b}$ in terms of a.

$$\frac{xy}{b} = \frac{12\ y}{\frac{(12)}{a}} = \frac{\text{No. of berth months}}{\text{No. of launchings}} = ay \qquad (4)$$

$$\text{or } b = \frac{x}{12} \cdot \frac{12}{a} = \frac{x}{a}$$

$$\frac{xy}{b} = \frac{xy}{\left(\frac{x}{a}\right)} = \frac{ay}{}$$

Substituting (4) in (3) : $\left(\text{ ay for } \frac{xy}{b}\right)$,

the equation (3) becomes

Steel locked up in one month $= \frac{b}{y}(ay - a)$ .....(5)

Total steel locked up for y berths

$$= \frac{b}{y}(ay-a) + (ay-2a) + (ay-3a) + \ldots\ldots 0$$

$$= \frac{b}{y}\ a\left[(y-1) + (y-2) + (y-3) + \ldots\ldots 0\right]$$

Hence for y berths work-in-progress :

$$= \frac{ab}{y}\left[(y-1) + (y-2) + (y-3) + \ldots\ldots 0 \right]$$

$$= \frac{ab}{y} \frac{(y-1)\,(y)}{2} \quad \text{as } (y-1) : (y-2) : (y-3) \text{ is in arithmetical progression.}$$

$$= \frac{ab\,(y-1)}{2} \quad \ldots \quad \ldots \qquad (6)$$

For (y—1) berths work-in-progress :

$$= \frac{ab}{(y-1)}\left[(y-2) + (y-3) + (y-4) \quad \ldots\ 0 \right]$$

$$\text{i.e. } \frac{ab}{(y-1)}\left[\frac{(y-2)\,(y-1)}{2} \right]$$

$$\text{i.e. } \frac{ab}{2} \cdot \quad (y-2) \quad \ldots \quad \ldots \qquad (7)$$

Since $(y-1) > (y-2)$; the reserve steel for y berths is more than *for (y—1) berths.*

Flexibility of Work : It is seen that production per ship per month is given by the formula $= \frac{b}{y}$

for $(y-1)$ berths—production per ship per month $= \frac{b}{(y-1)}$

$$\frac{b}{y} < \frac{b}{(y-1)}$$

If for a berth $\frac{b}{(y-1)}$ is the achievable capacity based on facilities,

Flexibility is more for y berths when compared to (y—1) berths.

Event completion :

No. of months after keel laying up to a certain period of time of decommissioning a berth } = z

Once a decision is taken to decommission a berth, the conditions prevailing up to the time of decommissioning the berth will refer to conditions of 'y' berths and the subsequent activities should follow the conditions of (y—1) berths. The amount of steel locked up on the berth where the next launching is to take place is as follows :

The number of months to launch the ship after the decommissioning of berth is determined by calculating the amount of steel erected already at the time of decommissioning. Therefore, the balance of steel to be erected for launching is $\left(x - \frac{bz}{y}\right)$

No. of months to launch the next ship after decommissioning a berth i.e., (y—1) berths $= \dfrac{x - \frac{bz}{y}}{b/(y-1)}$ ..... (8)

Equation (8) determines by finding out the balance of steel work to be done divided by the production per month which is $\frac{b}{(y-1)}$ in case of (y—1) berths. If the decommissioning is delayed, then the numbar of months required to launch the ship will be

$$= \frac{x - \frac{bz}{y}}{b/y} \quad \ldots\ldots\ldots \quad (9)$$

Equation (9) is obtained in the same way as in equation (8) but difference is that the balance of steel work divided by the output per month with 'y' berths only i.e., $\frac{b}{y}$, and hence the equation (9) has been arrived at.

(8) < (9)—as the denominator in (8) is more than the denominator in (9).

Hence, the launching event takes place earlier in (y—1) berths when compared to 'y' berths.

Definition of z and its relationship with a : 'z' is defined as number of months elapsed after keel laying upto a certain period of time when it is decided to decommission a berth. Decommission is possible only after a launching, hence 'z' is related to 'a' and also 'c' construction time. Once a berth is decommissioned, the first available berth for the next launching is 'z' for that berth say z will be $z_1=(c_1-a)$. z for the next berth where the 2nd launching is planned after the decommissioning is z_1 (c_1-2a). z for the y berth will be $zn,=(c_1-ya)$, This will be zero when decommissioning takes place, and therefore, the construction time c_1 will be equal to ya, as by the definition of z, it is the number of months after keel laying upto time of decommissioning. In this case, it is zero as the launching is done for this ship when a decision was taken to decommission a berth.

Vacancy of Berth : This ultimate objective is launching at a particular time. The construction time is given by xy/b;

For (y—1) berths, this works out to $=\frac{x\,(y-1)}{b}$

Difference between the two gives the number of months the keel laying event can be delayed to have the same launching. Hence, the same period is the extended period of vacancy of berth i.e., in (y—1) berths, the keel laying can be delayed by

$$\frac{xy}{b} - \frac{x(y-1)}{b}$$

Lead Time in Procurement of Meterial : Since the keel laying event can be postponed in case of (y—1) berths, the extra lead time available for procurement of steel materials will be the same period as given above.

Summing Up

Construction of ships (hull only) on reduced number of berths results in the following :

(a) There will be reduction in construction time.

(b) Supervision can be more effective since area of work is not so widespread.

(c) The work in progress can be reduced.

(d) Flexibility of work is less when compared to the achievable capacity on berth.

(e) Event can be advanced.

(f) The vacancy of berths can be delayed.

(g) More lead time for procurement of steel and for planning.

Consideration for a Firm Choice

It is seen that all items except d give definite advantage for fewer berths, and hence the number of berths should be minimum. However, the item mentions the achievable capacity in berth which becomes the limiting factor in the firm choice. Hence the number of berths is determined by this item i.e., b/y.

Efforts to increase b/y

It is advantageous to have 'y' as 1 since the benefit will be maximum. The production capacity in a month in this case is confined to one ship instead of a number of ships on berths and hence congestion of work on ship will be increased. This can be avoided by directing the work to prefabrication stage by providing heavier cranes and making heavier panels.

REFERENCES

William H. Newman, Charles E. Summer, E. Kyttywaren : Process Management Concepts, Behaviour and Practice.

Productivity in Railway Operation

T. C. Sarkar

It is well known that a widespread railway network can annihilate distances between industrial areas and their corresponding markets. Needless to say, railways do contribute positively to step up the economic growth. But, unless the productivity of railway operation is increased, industrial activity will slacken, and consequently, economic growth.

The concept of productivity is useful in railways in determining the profitability of special types of wagons to meet the transport requirements of special commodities. The transport of such traffic involves much empty running of wagons. The use of special type of wagons will be profitable if their productivity (net tonne-kilometre) is higher than that of the corresponding units of general service wagons.[1]

Railway operation mainly consists of: station working—receipt and despatch of trains and performing shunting on them; running of trains—work done by the train crew and the controller; yard working—breaking up of incoming trains in order to form new ones.

Assessment of productivity of station operation may be made from the uninterrupted running of all trains i.e., avoidance of delay of trains at the station or outside the signals. Average detention to incoming train engines over the target laid down may be taken as another index at terminal stations. While productivity of the running of trains may be assessed from the punctuality figures, that of yard operation may be known from:

(a) Average detention to through and all wagons;
(b) Average number of wagons dealt with per shunting engine hour;
(c) Pecentage of wagons damaged in relation to wagons shunted;
(d) Percentage of trains having late start, and average late start per train;
(e) Percentage of trains detained at the signals and average detention per train.

The above figures are useful for the comparison of output of the same yard at different time periods. In order to have a correct appreciation of the variation in these figures, it is essential to fix tolerance limits for them in order to indicate whether the variation reflects a significant change in their values or is due to chance and random causes. "Without a knowledge of the acceptable tolerance limits of these statistics, there is little point in undertaking the vast labour of compiling them".[2]

Once the problem area is located, it becomes simpler to find ways and means to overcome such problems if : (a) better methods of working are adopted; (b) better equipments are available; and (c) man-power available is utilised effectively; half the battle is won, in the sense, that productivity goes up and arrival and departure of trains is punctual To do so, some suggestions on the above-mentioned aspects are put forward in the subsequent paragraphs.

Methods of Working

The system of communication has to be improved so that messages may be sent and received instantly. The practice of sending written messages is out of place in the present tempo of working. Areas where improvement can take place are:

i) The shunting order may be conveyed to the engine driver directly. Shunting may be performed by the locomotive staff under the guidance of the station staff. Shunting signals should be brought into use. Similarly, the caution order need not be signed by the guard before it is taken to the driver. Considering that the authority to pass a defective signal is delivered directly to the driver, there is no reason why the caution order has to be brought to the knowledge of the guard.

ii) Dwarf starters or disc signals may be provided where there is a common starter governing the departure of trains to allow starting of trains without issuing a written authority.

iii) Installation of electric key transmitters at roadside stations will minimise the time taken for movement between stationmaster's office and locked points.

iv) At the repacking stations for trains dealing with "smalls" a telephone should be provided for easy communication between the guard and the assistant station master.

v) Wagons remain idle for about 18 hours a day in the marshalling yards. The provision of teleprinters, paging and talk-back telephones and walki-talkie between the yard master and the staff in the yard can expedite the work in a yard through improved communication.

Equipments

The provision of improved facilities in yards, stations and for the movement of trains is discussed below:

YARDS—(i) Modernisation: A yard may not function efficiently because the lines in it may be smaller than the length of the trains required to be dealt with, the effective height of the hump may have decreased because of the gradual raising of the lines in the yard, or the track may not be suitable for a new type of locomotive working the trains. The lack of a shunting neck, the existence of a shunting neck of inadequate length, the lack of a locomotive reversing line, the lack of a water column or an ash pit—any of these may be a major factor for decreased productivity of a yard. Correction of these undesirable features will go a long way in increasing productivity of yards.

Transfer wagons undergo considerable delay at a station where separate up and down marshalling yard exists. They have, in fact, to be dealt with twice—once in each yard before they can be despatched. So the trend, all over the world, is to convert doublesided yards into a composite yard on one side of the running line where wagons for both up and down directions can be dealt with. Studies on the marshalling yards on the German railways have shown this to be promising field for effecting economy.[3]

(ii) Centralisation : The functions of marshalling yards situated within a short distance of one another may be centralised; the one centrally situated for purposes of formation of trains or provided with the greatest number of facilities may be developed so that it can take over the functions of one or more of the nearby yards. A study on this line has been made in most of the countries of Europe with satisfactory results. In Germany 17 marshalling yards were closed down since 1945 and 43 yards were remodelled. After remodelling the output of the yards increased with the same number of locomotives and operating sfaff and the cost of marshalling for each outgoing wagon was reduced.[4]

(iii) Mechanisation : In a hump yard the points are grouped on the inclined track, enabling the marshalling lines to be constructed in a compact form and the points are power operated. Retarders eliminate rough impacts between cuts of wagons and consequently, damage to the goods and the wagons. The turnround of wagons is quicker due to quicker movement through the yards and less damages.

The benefits arising out of mechanisation of marshalling yards were clearly brought out at Mughalsarai where the time taken for the marshalling of a load of 70 wagons was reduced from 25 minutes to 12 minutes, consequent upon mechanisation of the up yard. The actual number of wagons humped increased from 2,400 wagons per day to 3,200 wagons per day. The number of damaged wagons came down from 2 percent to 0.5 percent per day.

Locomotives—Diesel and Electric : More powerful diesel locomotives can be utilised on the same track for hauling heavier and faster trains. The longer cruising range of these locomotives allows through trains to be run to longer distances at a stretch without passing through-intermediate yards. The Report of the Expert Committee on Coal Consumption on Railways (1958) recommended that all shunting services should be progressively dieselised.

Wagons—Automatic Coupling : Automatic couplings should replace the screw couplings on the general service wagons The automatic couplings are stronger and more suited to the heavier high capacity wagons. They are specially useful in big yards where the time for uncoupling of wagons of an incoming train is greatly reduced and annual coupling of wagons on an outgoing train is eliminated. The work in the marshalling

yard is thus accelerated. Couplings will be less than that of the screw couplings and buffers, and work will not suffer during the period of a change over.

STATION—(i) Block Working : A train waiting for the arrival of another train from the opposite direction does not get a token until the incoming token is dropped into the token instrument and a fresh token is taken out for its journey. In the Japanese National Railway, this loss of time is eliminated by delivering the incoming token to the outgoing train, and it was once suggested that the same procedure should be given a trial on the Indian railways. It may, however, be remembered that in this system, the last stop signal cannot be interlocked with the token instrument and the lock and block system of working cannot be adopted.

The introduction of tokenless working in different sections of the Indian railways has resulted in increase in the capacity of those sections by about 15 per cent. A new D.C. instrument for tokenless block working has been described which satisfies all the requirements laid down in the Indian Railways Signalling.

Manual : This is considered preferable to the imported frequency modulated or D.C. impulse coded instruments from the point of gainful utilisation of existing resources and less cost of manufacture and maintenance; it involves no foreign exchange and can be introduced easily. [4] It may be pointed out that the full benefits of installing tokenless instruments will be felt only in the station where facilities for simultaneous reception of trains exist.

(ii) Route Relay Interlocking: At busy and large stations where several cabins exist for controlling the movement of trains, reception, despatch and shunting of individual trains take considerable time for setting points and lowering signals after going through the process of getting slot from other cabins. This time may be as high as 6 to 8 minutes at some stations. So route relay interlocking is being installed at many stations—suburban stations and busy junctions—specially where the signalling and interlocking gear and cables are old and require replacement.

These installations make it possible for the operating time for setting a route for a train to be reduced from 6 to 8 minutes to 3 seconds from signal to signal thus enabling a much greater number of movements;

other advantages are that the trains are not detained at the signals and crossings can be made even during peak periods.

With the provision of route relay interlocking at Kurla on the Central Railway, it was possible to increase the handling capacity through the yards from 206 trains in the peak period (5 hours) to 426 trains. At Churchgate, a terminal station on the Western Railway, it was possible to increase the receipt and despatch of trains per day with scope for further increase.

TRAIN MOVEMENTS—Centralised Traffic Control : Under the present system of working, the train controller receives the timings of all trains in section and records them on a chart in different coloured pencils for the different types of trains. It thus becomes easy for him to arrange crossing and precedence of trains and an uninterrupted flow of trains is maintained.

The type of controlling, described above, is indirect as it is done through the agency of the station staff. A direct type of control is known as centralised traffic control, which includes not only automatic block signal protection but also power operation of points and signals at sidings on an extended territory—in some instances a whole section of 100 to 200 kilometres or more—all controlled from a despatcher's office.

The despatcher's control panel includes a track diagram which indicates the progress being made by trains and from this information the despatcher can operate the points and signals in order to arrange crossings with the least delay to any train. On double line sections trains may be moved in both directions on each line and fast trains can be diverted to run around slower ones, all trains continuing to run at usual speed.

The advantages of having centralised traffic control are greater average speed of train, more gross tonne-kilometres per train engine hour, and greater use of motive power. It also effects economy by doing away with cabins and cabinmen at roadside stations. The increase in the sectional capacity of single line section has been found to be about 50 percent after installation of centralised traffic control. It must, however, be mentioned that the full benifit of such installations will be obtained only when the terminal facilities are adequate for free reception and despatch of trains.

Man Power

Handling of Staff : The workers are valuable instruments for doing work and are very sensitive. The best way of handling them is to treat them as rational human beings, and to recognise that they all have the basic needs like self respect and social approval. The genuine grievances of the staff have to be looked into. This is as essential as preventive maintenance of machinery in a production centre.

Training : For the purpose of getting the best out of workers a training programme on various subjects pertaining to Railway operation and maintenance has to be introduced which will make an interested worker conversant with the different branches.

Incentives : The question of granting incentives to workers arises because under ordinary conditions of working the workers do not put in their best efforts and the maximum productivity to which they are capable is not attained. The grant of incetives—either financial or non-financial raises productivity which benefits both the administration and the staff.

Bonus payments to their staff in order to promote punctuality are made by the railways of some foreign countries, e.g. Bulgaria, France, Poland and Spain. In the Spanish railways bonus payments are awarded to the train control centres which show the lowest monthly late running percentage. The Bulgarian railways have reported that their bonus system resulted in 98 percent of their passenger trains and 95% of their goods trains running on time.[5]

The shunting staff in the marshalling yards in the German Federal Railway are given an incentive bonus per hour of work, provided the work is satisfactory. This can be withheld by the yard master in case of unsatisfactory working for a period upto 6 days without calling for a written explanation from the staff concerned. Similar arrangement for payment of bonus to the shunting staff in some yards exists in the British Railways also. The bonus may be withheld for careless shunting leading to derailment, mis-shunt, damage to loads etc.

The grant of incentives to operating staff is of recent origin in the Indian Railways. It is reported that incentive schemes were drawn up in the

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In the first instance, there is wastage of electricity and capacity. In second instance, there is less capacity—a few rupees more could have saved the labour and also fuel.

Recently, a survey was made by the author, on 15 families right from the kitchen to "office going" stage and what was observed?—(i) wastage of electricity; (ii) wastage of fuel; (iii) wastage of water; (iv) wastage of linen; (v) wastage of food products. Some other factors are (a) unproductive movements from kitchen to parlour/bedroom, dining room; (b) unproductive movement from washing place to kitchen; (c) extra frequencies of marketing; (d) unsystematic way of cleaning and washing.

After studying these, a few suggestions were made to the families

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Centrai Railways to reward drivers and firemen for punctual running of express trains and for completing the sectional run within certain target hours while hauling a minimum prescribed load. The practice has not gained wide acceptance.

Rewards : Reward is given for services rendered. Here also it may be

concerned and they were requested to follow suggestions and to report the outcome. Surprisingly, they were able to minimise the wastage [for items (i) to (v) above] by about 5% and minimise the labour [for items (a) to (b) above] by about 7%. Of course, more detailed study could have helped to give more elaborate suggestions. However, this is a good achievement, no doubt.

Another question which could be studied was : How to find out whether an individual's investment on a particular household appliance is satisfactory? When a man considers an investment, he examines the matter with reference to (a) the probable/reasonable return on investment and (b) the safety of capital.

Similarly, when a new appliance is intended to be purchased for household use, the lady of the house has to think on the above lines. Here lies the difference between an industrialist and a house wife—the industrialist when he considers buying a new machine wants to know how safe is the capital and what the probable returns or earnings may be, whereas a housewife thinks how much labour she will save and how efficiently she can do her work with the appliance in question. This can include her labour and money she will save, if this was done from the outside or how much the appliance will help her to reduce her wastage. But how about the return on the capital invested ?

Let us assume that the annual saving of Rs. 200 are considered, based on cost calculation of particular appliance which included depreciation. This means that the annual depreciation (which is estimated on a straight basis Rs. 400/- per year) is charged into costs and as such is recovered over service life of the appliance from its output. In a period of 5 years the annual depreciation of Rs. 400 deposited in depreciation reserve fund (but not at interest) will amount to Rs. 2,000. Accordingly, as the basis of the estimates of the cost of service in which the use of a new machine/appliance costing Rs. 2,000 will result in annual saving of Rs. 200, over present process after accounting for full depreciation in 5 years. The investment may be considered satisfactory both as to the return on the original capital invested and also as to the service.

Coming back again to the savings on reduction of wastage, a most interesting feature can be drawn. In Calcutta Metropolitan Development Area, there are at least 1.6 million families where average expense is

somewhere between Rs. 200 to Rs. 250 per month. If an average is taken on saving due to reduction on wastage at the rate of Rs. 10 per family, then total savings will come to about Rs. 10×1.6 million $=$ 16 million rupees. If this money is invested. In an electronics complex, then at least 1,500 people can be employed. (In India if 10 million rupees are invested then at least 1,000 people can be employed).

A close analysis of the doctrine of evolution makes it clear that species develop not only by his own power to struggle but also by his association with his fellow beings and this association should lead to the bringing of local self-governing institutions involving increased importance on the part of the citizen. Huxley, for example, regarded it as 'the function of the society to control and supersede the struggle of existence, thereby making the community not a battlefield but a planned garden'. Hence, society has to take greater responsibility for a planned economy in the greater interest of the nation. Days have come when we cannot afford to neglect anything.

Public Sector—A Study on Capacity Utilisation

It is well recognised that there is much scope for improving the utilisation of capacity of a number of Public Undertakings. The Committee on Public Undertakings (COPU) focussed attention on the persistent underutilisation of capacity in some of the public sector enterprises. Subsequently, the Bureau of Public Enterprises (BPE) assigned a project to the National Productivity Council (NPC) to undertake a study on capacity utilisation in a selected number of units. The terms of the reference of the study were :

(i) to ascertain the position and the extent of utilisation of capacity in the given units;

(ii) to analyse the causes of underutilisation and quantify the losses in production; and

(iii) to indicate the areas where remedial action could be undertaken at the unit level.

Approach to the Study

The approach to the study is based on collecting relevant data on the subject through a questionnaire, followed by visit to the units for an in-depth study by a team of specialists. In order to test the methodology and to develop a questionnaire, a pilot study was conducted in seven representative units.

For administrative convenience, the main study was undertaken in phases. During the first phase, 35 units were covered. It is planned to cover 26 additional units during the second phase. Before commencement of the study, the Bureau obtained the consent of managements of individual units.

*This is an abstract from the final reports on Capacity Utilisation in Public Sector Undertakings, presented to Bureau of Public Enterprises by the National Productivity Council, New Delhi.

The study in the first phase was completed and reports were finalised after receiving comments from managements of the units as well as the Bureau. The following paragraphs provide some of the salient features of the findings of the study. The conclusions are based on the observations of a limited number of units as mentioned above and as such cannot be generalised.

Findings of the Study

Unit of Capacity Measurement : The unit of measurement recommended in Detailed Project Report (DPR) could not relate the quantum of activity performed by the enterprise in a realistic manner, due to factors like multiplicity of products, changes in product mix, diversifications etc. This gave rise to increasing number of representations to the parent ministries for suitable modifications.

Multiple units of measurement of capacity were recommended for adoption in the case of engineering enterprises. This included the unit of basic capacity in standard hours and physical output of the enterprise in terms of quantum of goods produced. In the case of process and chemical industries, this task was fairly easy, as the capacity could be specified either in terms of tonnes and/or number of goods produced.

Capacity Measurement : The study focussed attention on the achievability of the capacity assessed under the existing conditions of the plant, and such factors as the quality of available materials and similar other constraints. In most of the cases it was found that, the original DPR capacity conformed to the capacity established by the study. In the case of a few units, better exploitation of the equipment resources resulted in improvement of capacity utilisation to the tune of 10 percent of the DPR figure. In the mining and similar units, where the capacity is linked to the performance of labour and aging of the mines/plants, the capacities were to be marginally downgraded. But, by and large, the rated capacity of the units more or less conformed to the DPR recommendations.

Capacity Utilisation : The utilisation of capacity was calculated for a period of three years (1971-74), comparing the physical production achieved with the newly established rated capacities.

One striking observation during this exercise was, that, in general, chemical and process units were operating better, with a utilisation of the order of 70 per cent and above, while engineering units were able to achieve a utilisation between 25 and 60 per cent. This could be attributed to the vagaries of the internal market and technological and other problems of exploiting capacity. In the case of process units the utilisation of capacity was better, mainly because of the relatively econmic size of the plants and their better manageability due to continuous product/process lines.

The performance of fertiliser and refinery units had been ranging between 70 and 100 percent, while that of the heavy engineering units was around 50 percent. The heavy engineering units are huge and complex and the market is considerably influenced by the policy of industrialisation in the country, while the fertiliser and refinery units have discrete product lines. By and large, the capacity utilisation of the public sector units lay between 50 and 60 percent.

Major Factors Responsible for Underutilisation

Unit Level Factors :

(a) *Management Deficiencies* :

(i) *Machine Breakdown :* Lack of organised effort to maintain plant and equipment resulted in considerable downtime and underutilisation of capacity. This factor assumed greater importance in more than 75 percent of the units studied.

(ii) *Lack of Effective Planning System* : Detailed and integrated planning was found to be absent in most of the engineering units, thereby resulting in considerable idle time of plant and machinery.

(iii) *Inadequate Marketing Efforts* : The units as a whole did not seem to lay due stress on the marketing function and promotional activities to popularise the existing products brands. Efforts for securing orders for achieving better utilisation of capacity were also not up to the mark. This could be partly

atttributed to the peculiar nature of the product-mix under taken. However, the managements could have explored the internal as well as export markets.

(*iv*) *Diversification and Development of Technology :* Barring a few, the units were generally not found to be dynamic enough to keep pace with the needs of the internal and export markets. Rapid technological development in their respective fields of production seemed to have made it difficult for them to keep in line with the development elsewhere and be competitive. They need to strengthen their R & D activities considerably.

(*v*) *Need for Dynamic Management Team :* Again, the organisational environment and the systems and procedures borrowed from the government had failed to enthuse the management teams to function as effective teams of business which is essential for running the units. To a large extent, delays in decision-making and such other factors were responsible for demoralising the managerial personnel which had resulted in ineffective utilisation of the built-in capacity.

(*b*) *Outdated Technology Borrowed from Abroad :* The product-mix planned by foreign collaborators of the units as far back as a decade or two had clearly lost its relevance to the new needs. Correspondingly, the technology provided had been relatively old and methods of production had become outdated and uneconomical. In some of the units, fresh investments are called for, for modernising the existing product lines.

Extraneous Factors :

(*a*) *Raw Material Shortage :* Almost all the units surveyed were handicapped by non-availability of raw materials. This can be attributed to the uncoordinated policy of the licensing and establishing industrial units without giving full consideration to the availability of raw material and other inputs. Distribution of some of the industrial raw materials is required by the government. Also, the general shortage of raw materials in the country has been responsible for considerable under-utilisation of capacity in the public sector. In some units, particularly,

the refineries, the policy of allocation of the crude has resulted in underutilisation of capacity of the order of 10 to 15 per cent.

(b) *Power Shortage :* This has been a common phenomenon for the last two years. Only a government policy for developing infrastructure facilities for industrial growth on a priority basis can help solve this problem. Fertilizer units, have badly suffered on account of power shortage.

(c) *Other Constraints :* Import restrictions and related constraints have induced a country-wide drive towards indigenisation. But capital equipment processes supplied by foreign collaborators work better with imported spares and consumables, the non-availability of which has considerably affected the performance of the plants. An example is that of indigenised catalyst used in fertilizer industries.

(d) *Vagaries of the Internal Market :* The large-sized public sectors engineering units have been suffering from lack of a potential internal market to absorb the production capacity. These units derive their orders mostly from government plans and developmental activities, but the government is not in a position to provide sufficient orders to keep the plants fully occupied. What is needed is a concerted effort on the part of the managements to develop new products which suit the requirements of the internal market and can be manufactured with the available technology.

(e) *Industrial Relations :* Over the years, labour unrest in the country has been increasing and industrial relations as a whole have become a major cause for concern in all the public sector units. This has been mainly due to lack of delegation to the unit managements and frequent intervention by central agencies. In spite of the amenities offered by the public sector units to their employees, they have been unable to get the best out of their workers. This matter requires to be looked into. This factor has greatly influenced capacity utilisation and efforts towards achieving rated capacity.

Factors Leading to Better Utilisation

Some of the public sector units need to be complimented for their creditable performance in achieving a utilisation beyond their designed capacity and increasing the plant capability beyond the design figure indicated by their collaborators. The factors that have made this possible are :

(*i*) A dynamic management team and a genuine concern for industrial relations;

(*ii*) plant modifications and removal of hurdles in the efforts for improving capacity;

(*iii*) quicker decision-making process to solve the plant level problems;

(*iv*) research and development activities for plant improvement and production development; and

(*v*) constant endeavour towards increasing the working efficiency through adherence to better operating and maintenance practices.

Conclusion

Public Sector Undertakings can do much better and contribute their mite effectively when the issues referred to above are given due consideration by concerned authorities.

Book Reviews

Planning and Agricultural Development

D. N. Jha

Sultan Chand and Sons, pp. x + 242, Price Rs. 30.00

Reviewed by Dr. M.T.R. Sarma*

This book is perhaps a typical example which reflects the general style and pattern of dissertations submitted to some of the Indian Universities for a Ph. D. degree. The fact that ICSSR has given a grant for publishing this book shows that apparently any graduate student of social services who can write a thesis can also get it published in India provided that he is guided by the right people.

The author tried to examine the following problems relating to agricultural development in Bihar :

(i) organizational arrangements relating to land reform measures, research to improve production possibilities and extension education programmes;

(ii) institutional arrangements, such as credit and marketing;

(iii) facilities for supplying new and improved forms of inputs, such as irrigation, fertilisers, improved seeds, pesticides, etc.

The study is based on the so-called documentary and interview methods of research. The author did not conduct any sample survey to collect any primary data. However, the field study made by the author is to "form an opinion regarding the effectiveness of agricultural planning in Bihar."

The author's appraisal of agricultural programmes in Chapter II lacks coherence and anything remotely associated with agriculture is blamed for the so-called "slow rate of growth in agriculture". A rate of growth of 3.01 percent per annum during 1952-53 to 1964-65 in Bihar, which is slightly more than the all-India achievement, is, however, no mean achievement. Chapter III dealing with "Agricultural Planning in Bihar" is again a sketchy description of various programmes outlined in the Plan

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documents. Chapter IV of this book deals with "Organizational and Institutional Factors". The author, after reviewing the Third Plan achievement, comes to the well-known conclusion that the land reform legislation in Bihar has been ineffectively implemented. This chapter also contains a description of the organization of agriculture research, education and extension services in Bihar during the Third Plan. After describing the institutional set-up of co-operatives in Bihar, the author concludes vaguely that "the co-operative agency in Bihar requires much orientation to become an effective institution to facilitate technological change." (p. 101)

Chapter V describes the progress of agricultural production and supply programmes in Bihar in the Third Plan period. Chapter VI is entitled "Intensive Agricultural District and Area Programmes." As the author has admitted, the data given in this chapter are culled out from the Second and Third Reports of the Expert Committee on Assessment and Evaluation of Intensive Agricultural District Programmes, published by the Ministry of Food and Agriculture (p. 137). No original conclusions or ideas emerge out of this presentation. Chapter VII on Irrigation Programmes in the Third Five Year Plan of Bihar is informative. It is interesting to note that "although Rs. 68 crores were spent on the major and medium irrigation projects, the additional potential of irrigation created in the Third Plan was only 6 lakh acres against a target of additional potential of 27.82 lakh acres" (p. 184). Chapter VIII presents the conclusion of this study.

As an after thought, the author has added a last chapter entitled "Epilogue : Agricultural Development in Fourth Five-Year Plan (1969-74) of Bihar". There is some sketchy and inadequate description of the objectives and strategy of the Fifth Five-Year Plan in one and a half pages at the end of this last chapter.

On the whole, this book will be of limited academic interest to the students of agricultural development in Bihar.

Green Revolution : The Unfinished Task

Centre for the Study of Social Change; Minerva Associates (Publication) Pvt. Ltd., 1974

Reviewed by R. K. Sharma*

This volume is a collection of eight papers presented at a seminar oganised by the 'Centre for the Study of Social Change' in New Delhi during October 1972. In addition, the volume contains a brief three page summary of the conclusions of the seminar and a note by Amritananda Das, giving a brief summary of the discussions.

The first paper 'On Green Revolution' by K. Mukerjee of Commerce Department in Calcutta University, is an ill-informed and confusing diatribe against green revolution. Mukerjee considers green revolution to be a chimera and goes to the extent of even denying the revolution in wheat production in Punjab. Moreover, he has substantial reasons to "suspect that if artificial distinction between agricultural and non-agricultural income is removed for income tax purposes, much of what passes as green revolution will simply vanish". Of course, he has neither stated any reason nor cited any evidence or references to support his thesis. Indeed, Mukerjee's paper does not contain a single figure or reference.

The next paper 'Green Revolution And What Next' by Dr. S. S. Johl, briefly points out the achievements and weakness of the green revolution and then goes on to discuss the problem of excessive dependence on wheat crop in Punjab. As a result of continuous increase in wheat output, farmers are becoming apprehensive of price fall and are looking for alternatives. Dr. Johl has analysed the comparative economics of various crops and livestock enterprises with a view to exploring the possible alternatives to wheat crop. He concludes that at the existing level of factor and product prices and technology, dairy enterprise offers a good alternative. He considers that 'wheat revolution' is around the corner. "Let us give it a little push; that is an important aspect of the next phase of the unfinished task in the areas affected by the green revolution in India".

* Senior Research Officer, Institute for Applied Manpower Research, New Delhi.

'Spreading the Green Revolution : The Tasks Ahead' by Ashok Thapar, a noted farm correspondent, concentrates on highlighting the various legal, social, political and economic hurdles in the way of institutional changes, specially land reforms. He chides the radicals for their refusal to see the realities, and concludes that "stubborn quest for 'institutional changes' uses up valuable time and energy which should really be devoted to promoting rapid technological change".

The next paper, 'A Charter for the Land' by B. B. Vohra, Chairman, Central Ground Water Board, is devoted to the problem of land and soil management. Vohra considers the present efforts in this area to be fragmentary, inefficient and without a sense of direction. After discussing in detail the various problems—soil erosion, water-logging, floods, salinity, and inefficient utilisation of irrigation—Vohra goes on to suggest a massive ten-point integrated programme, involving an investment of Rs. 23,000 crores over next thirty years. As a first step, he suggests an amendment to Constitution to place the subject of 'land' under 'Concurrent' list. In order to ensure effective implementation of his programme, Vohra has suggested the creation of a 'Central Land Authority' with "triple functions of a planning and policy making body at the national level, an executive agency responsible for the proper implementation of various programmes in the Central Sector, and a technical agency which can act as an apex organisation in respect of the various disciplines concerned with the assessment and management of our land and soil resources". A similar organisation is proposed at the State level.

In his paper, 'New Agricultural Strategy and Regional Variations in Foodgrains Production' V. S. Vyas has analysed the data on the output of foodgrains in the pre-HYVP period (1961-62 to 1964-65) and post-HYVP period (1967-68 to 1970-71) in different states with a view to test the popular hypothesis that green revolution has accentuated regional difference in agricultural production. The data presented by him show that both the agriculturally advanced as well as backward states have participated in the HYVP and have substantially benefited by it. "There is nothing in record of the first four years of HYVP to suggest that, by itself, the new strategy is likely to accentuate the regional imbalances".

The next two papers try to identify structural changes in agriculture resulting from the new agricultural technology. S. L. Shah and S. A. Ali (of Agricultural University at Pant Nagar) have used production function

analysis on the sample data of 60 farms in Terai area with a view to identify structural changes in agriculture. However, they end up in just giving input-output data, elasticities and R^2. Dr. A. S. Kahlon's brief note on 'The Impact of New Farm Technology on Structural Changes in Farm Organisation in the Punjab' also fails to make any significant point. It appears as if Dr. Kahlon hurriedly gathered few points from his earlier paper to write a paper for the seminar.

'Milk production with high-yielding animals for agro-industrial development and rural employment' by Dr. Sundaresan is a well-written and useful contribution. Dr. Sundaresan argues that in order to meet the increasing demand for milk, "there is no other alternative except producing high-yielding animals and planning dairying around centres with an abundant supply of nutrients for milk production through high quality fodders". He contends that in a period of 10 years, it is feasible to produce 20 million cross-bred cows in this country which would produce twice the quantity of milk that is presently produced by existing 70 million cows and buffaloes. Moreover, if cross-bred cows are supplied to the small and marginal farmers, it would help in solving the problems of under-employment and poverty. At the same time, Dr. Sundaresan has pointed out that dairy enterprise needs large investment, and therefore, Government would have to provide the necessary resources to the small farmers.

In the end a note by Amritananda Das gives a good summary of the discussions during the seminar. Besides, Mr. Das highlights the need for bridging the gap between technocrats and social scientists by means of interdisciplinary research.

"Vyawasthapan Mitra"– (in Marathi)

R. G. Joshi & S. L. Joshi
Manohar Prakashan, Kirloskar Press, Poona-9, 1973, pp. 283, Price Rs. 20.00

Reviewed by M. J. Naik.*

Books on management by Indian authors suitable to the needs of the

* Deputy Director, National Productivity Council, Bombay

Indian Management situation are scarce. More scarce are books in regional languages. It is, therefore, heartening to see a publication in Marathi specially written and meant for the Indian management and in particular the management in Maharashtra. The book is written in a very simple and lively language and also contains a number of cartoons to illustrate and emphasize the various answers given by the authors to the problems posed to them. The foreword to the book is by the eminent Maharashtrian Industrialist, Shri S.L. Kirloskar.

The authors, in their introduction to the book, have mentioned that they have written this book on what has been commonly known as case study method in management terminology. The book consist of 85 case studies in the sense that there are 85 problems posed by, it seems, the authors' clients which have been answered by them. The authors have given a subject-wise index also. But when you read through the book you find that the cases have not been arranged in a sequence nor does the subjectwise index separately prepared give us any definite clue as to whether the authors did wish to have any continuity or link with the various cases dealt by them.

The authors have given convincing solutions to some of the problems posed to them. The following are illustrations of the same. On psychological testing, reference checking of the applicants, on the interview techniques the authors have given sound practical advice suitable to Indian conditions (pages 108, 118, 131, 165 and 190). The reviewer agrees in particular to the limitations of psychological testing which are an aid and not the end by themselves, and as pointed out by the authors their limitations for selection of candidate for particular categories and levels. The problems faced by an imroper selection of a candidate, (page 54) and a proper training scheme devised for the particular organisation's requirement, (page 77), are worthy for consideration in the situation prevailing in Maharashtra.

Good communication systems and an effective 'House Journal'—how they ought to be—are discussed with sound practical reasoning (pages 98 and 127). Criteria for good Merit Rating is discussed (page150) and discussion of the performance assessment (page 173) is presented with practical suggestions for Indian conditions in general and for Maharashtra in particular.

Some of the other problems which have been answered by the authors are, to this reviewer's mind, open to challenge. The authors have answered a problem connected with Job Evaluation (page 89). In their reply to the problem, the authors while conceding the validity of the Point Rating System of Job Evaluation for Production Department, have criticised its utility for evaluation of the clerical, office and other staff. According to them, it is found to be subjective and on the basis of this assumption the authors go further in advising that the best method of Job Evaluation for these categories is the Ranking Method. This, to the reviewer's mind, is actually going back rather than keeping in tune with the current practices followed more or less all over the country by different organisations for Job Evaluation.

Similarly, in reply to the problem as to whether the owner should have discussion with a newly formed union and just because some employees have formed a union whether the matters in the factory have gone out of hand, the authors have replied that the owner should ask independent organisations to have an opinion poll in the factory to find out what exactly are the problems of the workers in the factory. Going further, they suggest that in an election, the management should advise the workers to vote against the union. To the reviewer's understanding of the peculiar industrial relations problems in the country, such a suggestion or solution to the problem seems quite out of context apart from smacking of paternalism, more so when the same authors advise the management to keep away from Union 'politics' (page 58). Apart from this, the very suggestion of the management, requesting the workers to vote against the union of which they have, it seems, become members is advising openly the management to follow unfair labour practices.

The authors have given in reply to a problem details about the existing organisational structure in one of the companies (page 17), but they have not drawn a new organisation structure as such to explain in detail how the organisation can change over and have a new organisational structure and chart.

This, however, seems to be in tune with their suggestion (page 49) of the practical difficulties and the limitations of having an organisational chart based on functional alignment. This suggestion really works for small organisations but as they expand, it may be necessary to have such alignments and charts.

The authors have used the case study method very effectively and the cartoons also give proper supplement to the analysis of the problem and as such the book may be found quite useful for the Marathi knowing young entrepreneurs, who may have no inclination nor have any desire to study the management science from either the institutions or through other detailed books which are available in the country.

Pricing and Investment in Public Enterprise

Institute of Public Enterprise, Hyderabad
Oxford & IBH Publishing Co., 1974, pp. 342; Price Rs. 35.00.

Reviewed by C. M. Sastry*

The public sector in India has shown a poor performance for many years. The overall profit made for the year 1973-74 by the public sector enterprises was only Rs. 64 crores—a return of just over 1% for the public sector as a whole, but still an improvement over 1972-73 which showed a profit of only Rs. 18 crores, and the woeful performance of 1971-72 which landed the public sector in a loss of Rs. 19 crores. Capacity utilization still remains poor. While some have reached 75% there were others which were still operating below 50% capacity. The need for finding solutions for public enterprise problems arises on two counts, i. e., (i) the heavy investment incurred by the government on these industries is not yielding results, (ii) it has been criticized by people against its working as well as its very existence because of its inefficient performance.

Two all-India seminars were conducted by the Institute of Public Enterprise to analyse the multifarious problems faced by the public enterprises with a view to find out suitable measures to solve them as expeditiously as possible. The proceedings of the seminar as well as the papers read is brought out in the form of a book. This book contains a candid

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discussion on some of the crucial aspects of the working of public enterprises in India by eminent scholars and a cross-section of top-level enterprise executives.

The first seminar was held at Bangalore in September 1969. Seventy-one top level executives from the public sector undertakings participated in the seminar. The seminar has concentrated its attention on three issues, namely, pricing techniques and practices, township outlays, and investment and capitalisation problems in public sector undertakings.

In the session on pricing techniques and practices, Prof. Ramanadham has presented a paper discussing various pricing techniques in vogue with reference to Indian public enterprises. Also the pricing techniques and practices of various public sector undertakings were presented by their financial advisers or managing directors. Except for understanding each other's problems the discussion did not lead to any agreement regarding whether prices should be fixed by arbitration or negotiation, or by the bureau, or by some independent commission free from governmental pressure or political influences.

The next topic of discussion in the seminar is about township outlays. The Chairman of the session Mr. K. T. Chandy, Chairman, Hindustan Steel, suggested the appointment of a commission to study the problems of townships in all its complexities. The next session dealt with investment and capitalization problems in public sector undertakings.

The second seminar was held at Delhi during 23-25 Jan. 1970. Mr. B. Sivaraman, Cabinet Secretary, Govt. of India, who addressed the seminar, felt that the ills of public enterprises were due to lack of proper planning. He felt that with an increase in efficiency, many problems of pricing and investment would automatically disappear.

Six vital issues which have a bearing on public sector enterprise performance have been taken up for discussion. The six topics chosen for the seminar were: accumulated deficits, debt-equity ratio, determination of enterprise-wise targets, landed-cost basis of pricing and the concept of a public enterprise commission. The group has carried out intensive discussions on the issues raised, and suggested the following remedial measures.

(*a*) *Accumulated deficits :* A cash grant from the govt. may be justified where the enterprise with accumulated deficits has reasonably good prospects in the future.

(*b*) *Debt-Equity Ratio :* (i) Periodical reviews of the ratio are necessary, depending on the circumstances of individual enterprise. (ii) The ratio should be devised appropriately with the nature of price constraints and under utilisations traceable to past investment mistakes.

(*c*) *Determination of Enterprise-wise Surplus Targets :* (i) The surplus targets should be related to the total capital employed; (ii) The surplus targets should give due consideration for the price constraints and the social cost that govern the enterprise.

(*d*) *Landed-Cost Basis of Pricing :* (i) Landed-cost can be only one of the several possible bases of pricing; (ii) A better basis will be standard cost under reasonable conditions of efficiency under the Indian conditions.

(*e*) *Inter-Enterprise Pricing :* (i) The pricing decisions as between one public enterprise and another should be taken on the merits of the product and the socio-economic considerations attaching to it; (ii) The principles of enterprise pricing should be arrived at in broad terms and ad hoc price determinations should be avoided.

(*f*) *The Concept of Public Enterprise Commission :* (i) The Commission will be an expert body entrusted with work that is best left outside the purview of the Bureau of Public Enterprises; (ii) The Commission should be recommendatory and final powers of decision shall vest with the government.

The conclusions cited above represent the broad consensus of the seminar; it is not claimed that every participant agreed with every recommendation.

To conclude, the book throws much valuable light on such aspects as accumulated deficits, debt-equity ratio, determination of enterprisewise pricing, the landed-cost basis of pricing, concept of a public enterprise commission of pricing, township outlays and investment and capitalization. In all, nine working papers were presented at the two seminars

on the basis of which discussion took place.

The Institute of Public Enterprise deserves congratulations as it has done a good job in organizing the two seminars and bringing out the proceedings of the seminars as well as the papers read in them in the form of this book. The conclusions and policy implications emanating from the book calls for serious attention of the government and public bodies in the interest of the country.

Welfare Versus Freedom

Evan Bitsaxis

Olympic Editions Ltd., 5-Heraclitu Street, Athens 136, Greece. 1972, pp. 383, Price $10.00

Reviewed by Navin Chandra Joshi*

In its four parts of 28 chapters, the book touches upon several aspects related to welfare economics in general with a hindsight of freedom—political or otherwise. Getting off to a slow start with a general discussion on issues relating to science and logic, the author treats us to a lucid and an enthralling explanation of what faith means to science and what science means to economic welfare.

In an unconventional style of writing, the author proposes the thesis that the state theory should be regarded in a composite and nationless way. Indeed, the hierarchy of cultural and economic values becomes ultimately a matter for national decision.

As the attainment of minimum welfare depends on development, it is tragic to retard the latter because of political prejudices and misunderstandings between developing countries and the rich nations. In that sense, the consensus of donor and recipient countries about the context of state values is not an academic affair; it may serve the cause of economic progress".

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The author further observes that there are no statistics evidencing that parliamentary freedom has ever proved the major obstacle to aggressive and rapid development. The conflict between freedom and welfare has always been decided in favour of the latter even within the mature capitalistic economy of a democratic political tradition. The author seems to believe that economic welfare and freedom will be in conflict even in a developing country whether or not it is accustomed to a democratic tradition. Hence, the synthesis of freedom and economic welfare poses a new challenge for enlightened politics. Where freedom and economic welfare cannot be bridged otherwise, freedom must become the servant of tangible prosperity.

The author also briefly touches upon the issues of unemployment, inflation and economic policy. Being one of the worst enemies of economic welfare, unemployment is of less mysterious origin than inflation. By appropriately manipulating all the suspects of inflation, the policy maker may prevent inflation or slow it to a manageable pace. However, to the author, what is more necessary is to find out the 'personality' of inflation. On economic policy, the author concludes that flexibility in policy-making secures, in principle, an adjustment to any normal or abrupt change. Then it becomes possible to cope with cases of emergency or crisis.

The book warrants wide readership. Scholars of politics and economic welfare can symmetrically benefit from its clear and elaborate discussion.

Multi-Nationals in Developing Countries

Edited by S.P.S. Pruthi
Leslie Sawhney Programme of Training For Democracy, Bombay 1975;
pages 96; Rs. 10 00 (Hard Cover)
Reviewed by C.V. Rao*

The role of Multi-National Corporations came under fire a few years back when a Multi-national's hand was suspected in *coup' detat* in Chile in 1971. Since then, their role is being discussed in various forums all over the world. Even, United Nations formed a group under the Chairmanship of Mr. L.K. Jha to study their role, especially in developing countries.

One such seminar, on the subject was held in December 1974, under the aegis of Leslie Shawhney Programme of Training for Democracy. The book under review is the proceedings of the above seminar. By and large, a seminar is called for to study a particular problem from various angles and all points of view are considered, assessed and then a fairly good cost-benefit analysis is made. But a seminar bent to thrust a particular viewpoint is not only biased, but is completely prejudiced about the views held by its critics. The above seminar was also one of this kind. Dr. Pruthi gives a preliminary background of the subject in his introductory remarks, and tries to answer whether MNCs help developing nations. But this he does with a pro-MNC attitude and, hence, mars the charm of encouraging free exchange of ideas. That apart, contributions from Freddie Mehta and Sharu Rangnekar deserve more attention, as compared to others.

Freddie Mehta focusses his attention on the emerging trends on world economy vis-a-vis India's economic situation. One has to admit that the projections/estimates given by the economists can go wrong because of the dynamic situation prevailing in most of the economic systems.

However, in the light of oil crisis prevailing all over the world and hyper-inflation prevalent in most advanced economies, Dr. Mehta has suggested that in the years to come even the countries like USA would find it difficult to export the food grains. Even if they do so, it would be available at high prices and countries like Brazil, Indonesia, Malaysia, etc., which form the Third World would be first in the queue to purchase

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foodgrains (as they are well ahead on their way to industrialisation and hence, have achieved a high rate of growth), whereas, India would be last in the queue, for we do not have sufficient finance to purchase either today or if the present trend continues, even in future (about eight to ten years from now). So in the light of this, Freddie Mehta has suggested that the attention should be paid more to the agricultural sector and more so to agro-based industries.

But while defending the Multi-nationals, Sharu Rangnekar has presumed lots of things and presented a very biased picture. Undoubtedly, developing countries would like to have a Coca-cola culture, provided, it is healthy and contributes positively to the economy of the recipient country. But unfortunately, the culture which has been brought by the Multi-nationals to developing countries can be easily compared with the culture brought by the East India Company two centuries ago to India. Moreover, Rangnekar forgets that inappropriate investment in non-essential products can at times change the consumption pattern of a developing economy.

While talking about the feudal notion of profitability, Rangnekar has wrongly compared the policies advocated by the critics of the multi-nationals with that of canvassing chastity belts for prostitutes. A simple question can be asked: whether he would allow a multi-national or its subsidiary to earn super-normal profits which extract the consumers' surplus and leaves little with consumers to save. The reviewer feels that Rangnekar would not like it.

At another place Mr. Rangnekar deals with jealousy of success. He is of the opinion that a developing country wants a multi-national corporation's investment, its techniques, its employment, its products, its orders and its agency. And, he is also of the opinion that a Multi-National Corporation can provide all these because of their success in 'Professional Management'. But the reviewer is tempted to pose yet another question to the author : were the present day developed nations or MNC's assisted by some external agency in their stage of development ? As far as the reviewer knows, there were hardly any such instance. After all, developed nations have become economically viable not within a decade or two or being ruled by another nation for decades together. They could do so because:

(i) they had ample time to commit mistakes and rectify them;

(ii) they invested huge amount of funds in Research, Development and Design for a long period. It is not that they invested in the past and are reaping its harvest. Even today large chunk of investment goes in for Research, Develepment and Design.

In developing countries in general, and in our country in particular, the goverment is yet to give an opportunity to the entrepreneurs to develop heir own techniques and evolve suitable methods to solve their own socio-economic problems. The reviewer feels that the entrepreneuers in our country have not been given this opportunity and hence become victim of foreign agenciesf or their investment and technology. A very fundamental question can be asked that in the light of industrial policy of our country was there any point of time when the administrators thought of discouraging the foreign collaboration and giving a free hand to local entrepreneurs by giving them licences and allowing them to develop on their own. Had this been the case, the reviewer feels that an enterpreneur for his survival would have attained a success. Unfortunately, as is the case, our present day entrepreneurs and administrators have fallen a prey to the demonstration affect posed by the West.

Further, according to Prof. (Mrs.) Chishti, it is not essentially for techno logy that a developing country is paying; it is the perpetuation of monopoly rights of Multi-Nationals in technology which is being paid for by the developing countries[1]. Apart from this, though, Sharu Rangnekar has cynically stated that ".....the technologies given by the multi-national corporations are considered the cause of our underdevelopment—since these prevent us from developing our own techniques" (Page 58), the reviewer rightly believes that this really has happened with our industrial sector.

At another place, Sharu Rangnekar has painted a gloomy picture of our R & D activities and the performance of research laboratories in India. In the recent past, R & D activities in India are being geared up and more stress is being given to develop indigenous technology to suit our own climatic conditions.

1. *PRODUCTIVITY*—July-Sept. 1975, Vol. XVI, No. 2.

The last chapter in the book is on the report of conclusions. The conclusions are mainly based on the two papers of Freddie Mehta and Sharu Rangnekar. The Seminar identified the inhibition and biases against, MNCs (Page 91), which are nothing more than sweeping judgements over an important issue like whether Multi-nationals should be allowed to develop in India or not.

On the whole, the book speaks more in favour of the development of the Multi-nationals in developing countries and the reviewer feels that the book is incomplete unless the critics of Multi-nationals are invited to such seminars and in future, given equal coverage in the book. Then the future seminars would be able to assist the government in taking correct decisions. It is hoped that the Leslie Shawhney Programme of Training for Democracy should invite people from a broader strata of economists, executives, political scientists and administrators, who view the problem from all sides.

New Books : Annotated List*

Administration in General Practice

Owen, Helen

London, Edward Arnold, 1975, 143pp, £4.20

This book deals comprehensively with the main subjects on the syllabus of the pilot course in Practice Administration, which has been held at several colleges in collaboration with the Association of Medical Secretaries. Post-graduate courses including lectures dealing specifically with Practice Administration are also dealt with in the book.

Co-ordinated Work Measurement

Piercy, B and Jandrell, R

London, Edward Arnold, 1975, 200pp, £5.50

The principles, development and application of co-ordinated work measurement projects are neatly discussed in this book by outlining a structure in which the various activities are related and integrated. It explains the importance of each element, from the basic terminology to the final agreements, discusses the preparations required for each stage of a project, and illustrates the use of all the necessary standardized forms and documents.

Data Reduction—Analysing and Interpreting Statistical Data

Ehrenberg, A.S.C.

London, John Wiley & Sons, 1975, 391pp.

This is a basic book on statistics which provides a radical new look at both methods and problems. It makes explicit what is best in ordinary statistical and scientific practice. The main aim is to teach numeracy which is essential to analyse and interpret numerical data. It emphasises

*Prepared by Mr. S.N. Vig, Documentation and Information Officer, National Productivity Council, New Delhi.

the use of prior knowledge in analysing data, by seeing whether it agrees with the previous results. The search is for results which are generalised, i.e., which hold good under different conditions, and hence can be used for predictive purposes. Other aspects covered are data handling, linear and non-linear relationships, descriptive statistics, frequency distributions and probability, stochastic models, multivariate analysis, sampling, statistical inference, the principles of experimental design, and the nature of explanation and theory.

Decision Methodology

White, D.J.

London, John Wiley & Sons, 1975, 274pp.

Attempts to identify the nature of the secondary problems and in some instances to indicate how they themselves might be formalised as higher level decision problems. Because of the fundamental importance of these problems, some attempt must be made to discuss them, thereby adding more understanding to what is required to answer questions which are at present resolved largely by a huuch.

Gaming-Simulation : Rationalle, Design, and Applications

Greenblat, Cathy S. and Richard, D. Duke

New York, John Wiley & Sons, 1975, 435pp,

In an attempt to bring together the growing body of gaming literature, this book includes reprinted as well as original articles on the subject. The result is an integrated collection of essays, which provides an overview and an in-depth analysis of selected facts of this newly emerging field, by the pioneers of gaming-simulation. The first part presents an overview of the nature and rationale of gaming-simulation. While second part examines the elements of game design and construction, the uses of gaming-simulation for education and training are

explored in the third part. The fourth part examines new areas and applications of gaming, including public policy, urban planning and social research.

Job Evaluation—A Critical Review

Livy, Bryan

London, George Allen & Unwin Ltd., 1975, 192pp, Rs. 57.00

A critical, objective appraisal of the main methods and applications of job evaluation, drawing on relevant research and theory, with its emphasis on practical experience are dealt with in the book. This is well-written and illustrated suitably. Description of the principles of job evaluation sets out to compare the relative usefulness and practical relevance of a wide range of methods within the overall context of remuneration policy and organisational effectiveness. The aim is to help the practising personnel specialist, in the knowledge of best current practice and the latest research.

Management of Information Technology—Case Studies

Adams, Elizabeth B

New York, Petrocelli Charter, 1975, 196pp, £5.25

Provides an economical and controlled laboratory situation for the analysis and discussion of facts, half-facts, and opinions regarding major typical problems within the administration and control of a data processing installation. It covers a wide range of material. Some of the topics discussed are : the evolution of a large, nationwide communication network; vendor-user relationships; middle management resistance; MIS analysis and design; financial implications of EDP; and, security of information.

Theory of the Firm

Crew, Michael, A

London, Longman Group Ltd., 1975, 182pp. £2.75

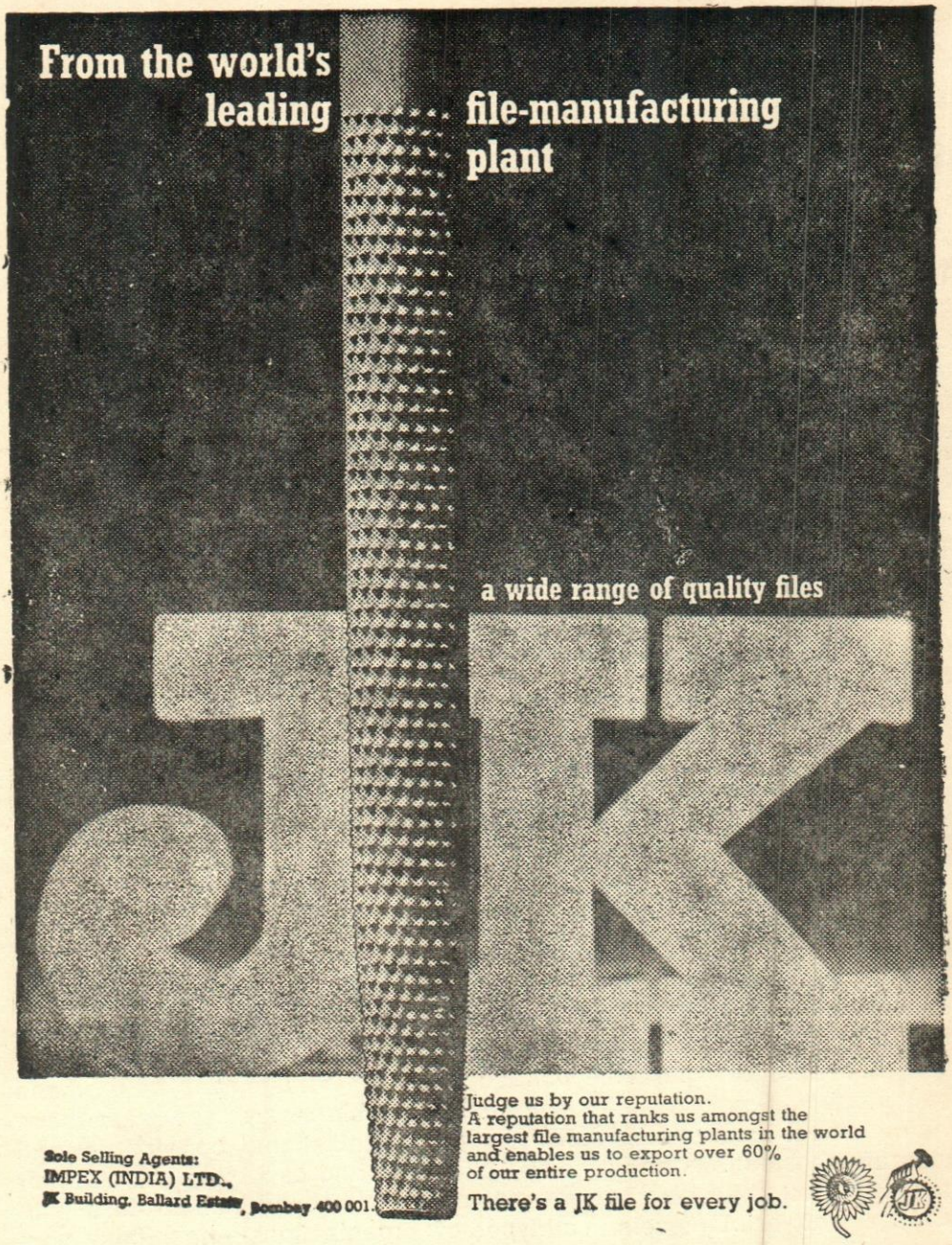
Outlines the nature of the firm in terms of economics and its relation to real firms. It analyses some of the major influences in the development and theory of the firm, and discusses the significant developments exemplified by the neoclassical theory, the programming analysis, and the neo-classical style models of market structure. From these traditional sources recent developments have been made in the fields of managerial motivation, behavioural theories, growth, risk and uncertainty. The regulation and performance of firms is a constant concern of public policy and the extent to which the book throws light on the behaviour of firms makes it topical. The book concludes with some of the author's own views on the possible extensions of the theory of the firm and their applications to public policy.

Theories of Management : Implications for Organizational Behavior and Development

Miles, Raymond E

New York, McGraw Hill, 1975, 240pp, $ 12.95

The text explores managerial choices among alternative approaches to leadership, job design, communications and control, rewards, and individual and organizational development. The text also presents the view that managers' personal philosophies of management help shape their strategies and decisions. Effective decisions are seen as those which reflect accurate perceptions of organizational constraints and accurate assumptions about human character and capability. The author traces three theories of management held by administrators and managers at various levels in all types of organizations—hospitals, government agencies, labour unions, business firms etc. The assumptions, policies, and implications of the traditional human relations, and human resources theories of management are examined and their effects on performance under various conditions are analyzed.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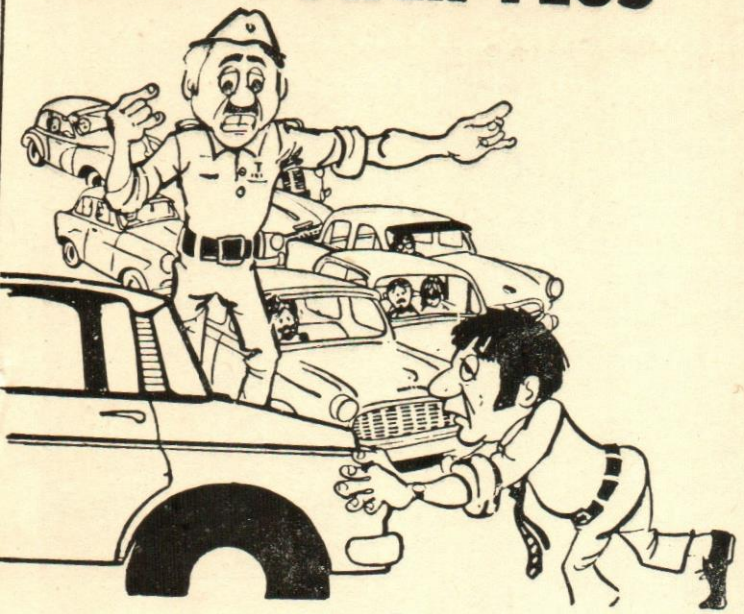

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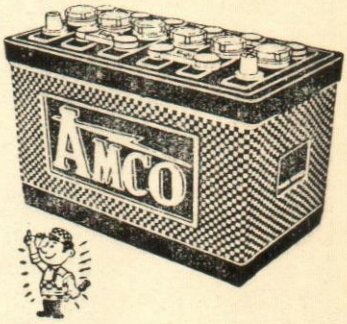

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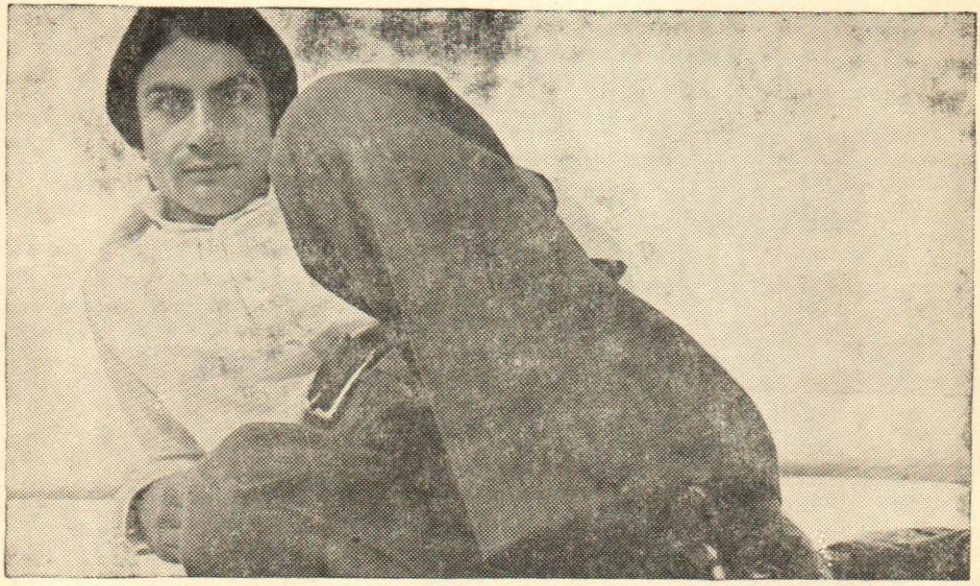

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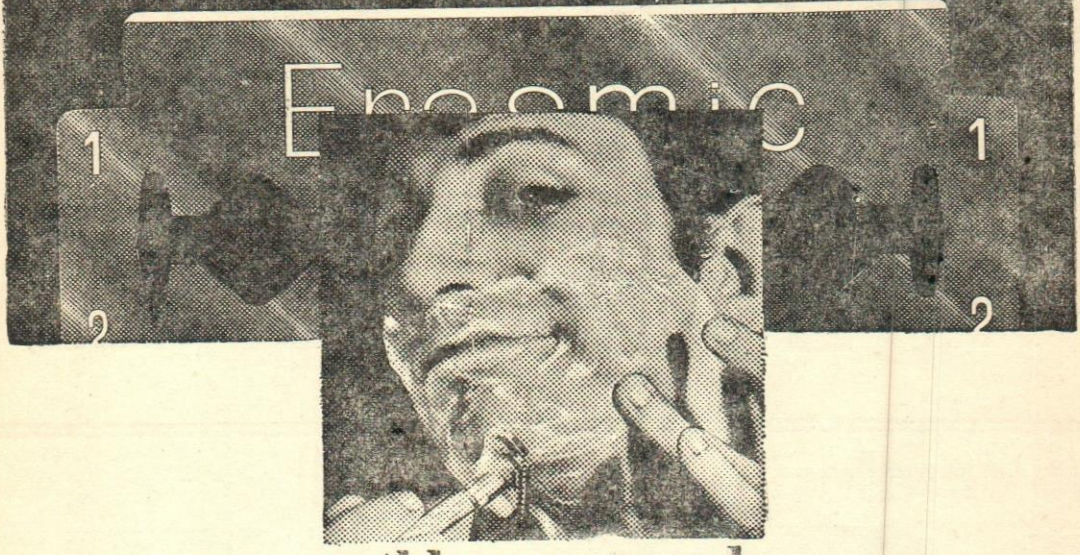

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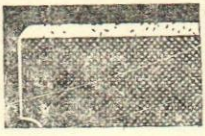
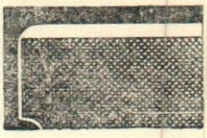


(Magnified view) Ordinary blades have a raw, naked edge. They cut your skin along with your beard.



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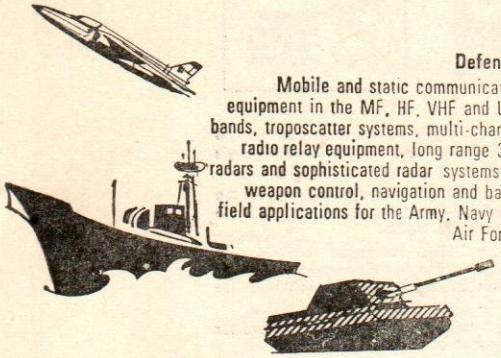

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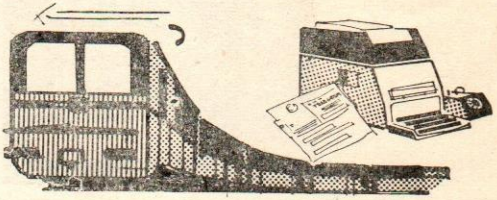

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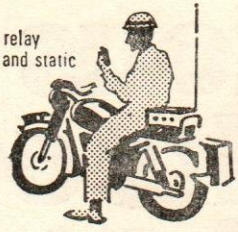

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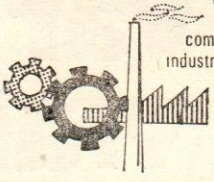

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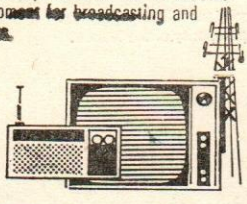

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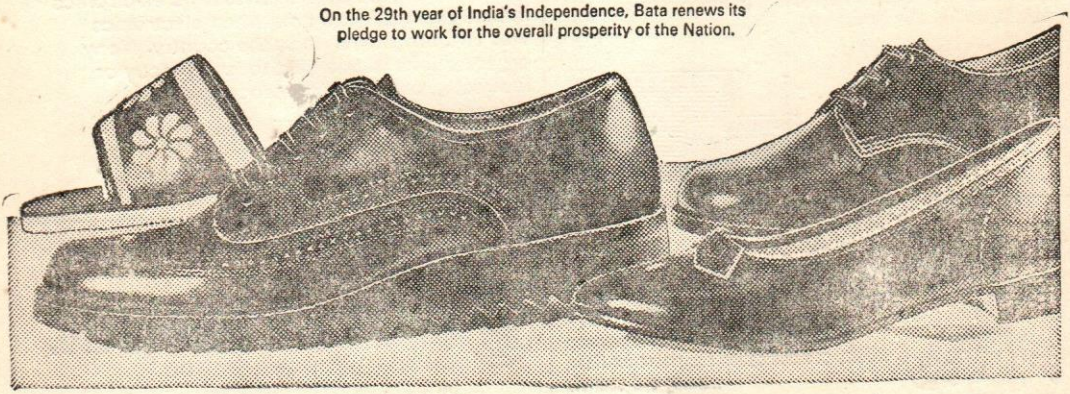

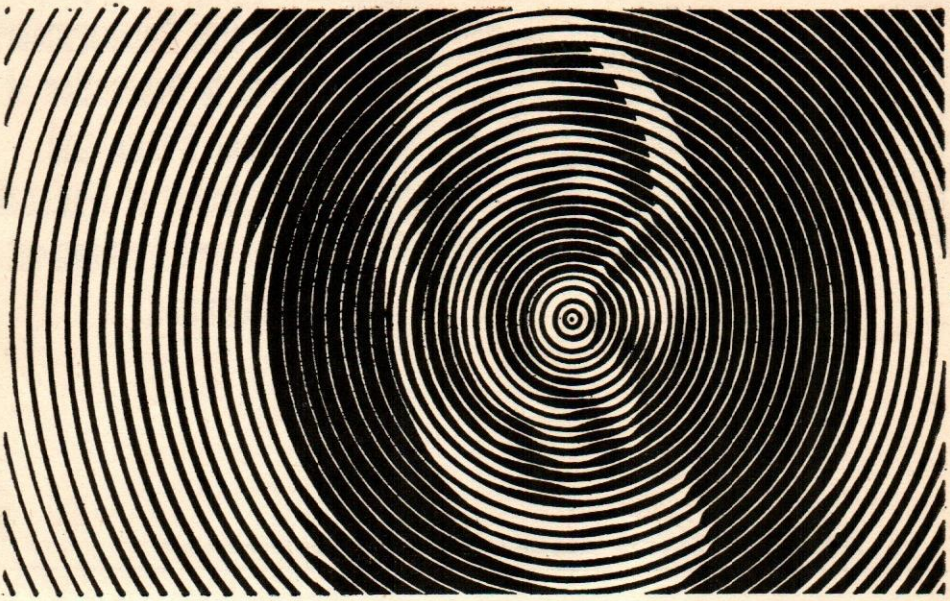

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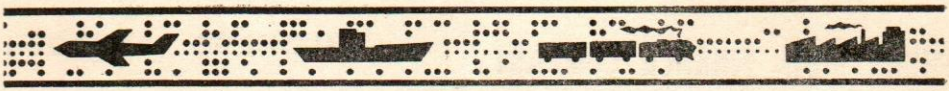

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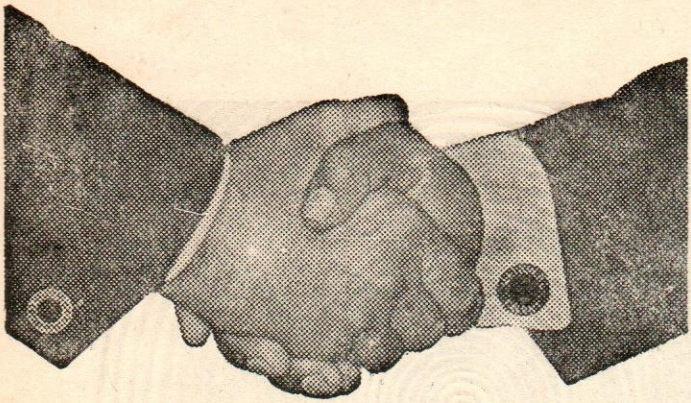

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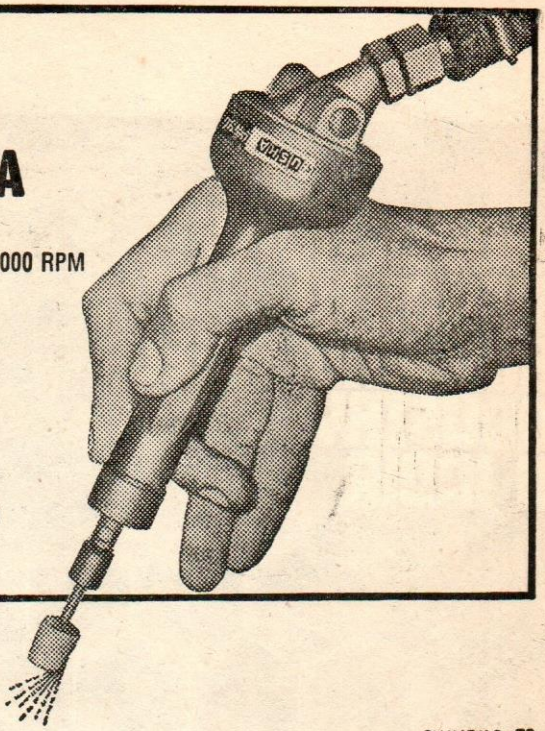

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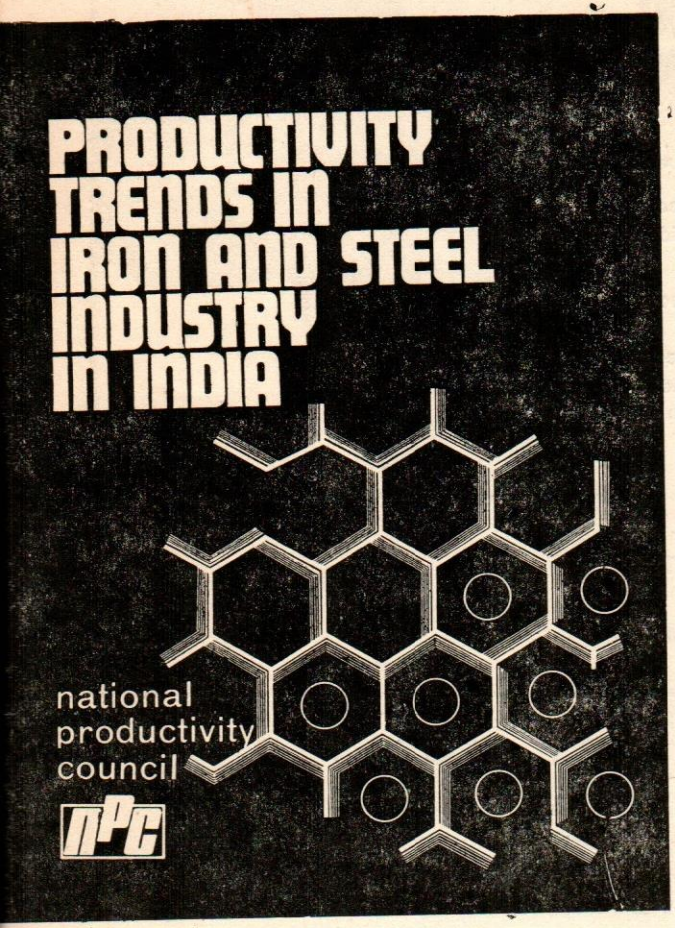

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Corporate Planning in the Context of National Planning

C. Rangarajan

Identifying the opportunities and constraints in the environment is considered as the essential first step in formulating a corporate plan. To what extent is this task rendered easy when a national plan exists for a country? What are the additional factors that are brought into play in such a situation? The nature and content of planning vary from country to country. At one extreme there are countries like the Soviet Union and China where nearly all the sectors of the economy are brought under the direct purview of the planning authorities. In contrast with this are countries like France which have attempted only to indicate the desired lines of development in relation to various sectors. Even in a seemingly unplanned economy like the United States, the government takes appropriate steps to formulate integrated schemes whenever the nation is faced with certain severe shortages or difficulties. In this paper, we shall focus attention on the implications of national plans for corporate planning in a mixed economy like ours, where both the private sector and the public sector have a role to play, but with the latter playing an increasingly important role.

In charting the future course of action, an enterprise scans the environment for suitable opportunities. The external information that an enterprise needs to collect for this purpose can be enormous. Thus, scannining by an enterprise ranges from what is described as 'undirected viewing' to 'formal search'. The national plan indicates the broad lines of development a country is expected to follow, and as such contains valuable information for a corporate planner. But, to interpret a plan meaningfully, it is necessary to have a clear understanding of the process by which the plan objectives and much more so, the targets for individual sectors have been arrived at. We, therefore, present first a brief review of the technique of planning adapted in India followed by an analysis of those aspects of the national plan which have a bearing on corporate planning.

Concept of Plan Formulation

Planning as a means of accelerating economic development, particularly in

developing economies, has been advocated on two grounds. First, because of the sharp inequality in income found in these countries, the market signals may not be good indicators of what the country needs to produce. This is apart from the fact that the markets themselves may be imperfect. What should be produced in the economy should, therefore, be governed by socially determined priorities which can be done only by a central planning authority. Second, planning by promoting a balanced growth of development could result in the avoidance of wastage of resources. The different sectors of the economy will develop in a balanced framework so that over-expansion in certain sectors which may occur under a decentralized decision-making system can be avoided. For these reasons, while adopting the mixed economic system, it was also decided that our country should follow a planned course of development.

In formulating a national plan, like in all other endeavours, the first task is to set the long run and short run objectives. In most of our plans, ensuring a particular rate of growth has been the dominant objective, even though other considerations such as reducing inequalities in income or securing a certain minimum level of employment opportunities have also been stressed. A second decision to be taken by the planning authority is on the strategy to be followed for achieving this rate of growth. At the time of the formulation of the Second Five-Year Plan, an issue that was widely debated in our country was on the strategy to be followed in our plans. It was stressed at that time that an emphasis on the development of basic and heavy industries was the best way to accelerate the long run growth of the country. There is no one standard route to be followed for achieving economic growth. Economic history reveals that there are many roads to economic progress. The planners have, however, to make a decision as to what they consider to be the best strategy to be adopted for the country. The third step involved in the formulation of a plan is to fix the magnitude of investment to be made during a plan period and the pattern of priorities to be followed in allocating this investment. To a very large extent, these would be determined by the objectives and strategy. And finally, the planners will have to decide on the proportion of the total investment that must be made by the government sector and by the private sector. All these four decisions are, to some extent, inter-dependent and cannot, therefore, be viewed in isolation. However, these constitute the major basic considerations that must be resolved by the planners before

embarking on a detailed sector-wise allocation of investment and output.

The Indian plans have very often been described as falling under the category of 'consistency' models. This is so because the endeavour has always been to construct a plan that is mutually consistent. This consistency demands that the different sectors of the economy grow in a given ratio. The input-output table, incorporating the flow of goods from one sector to another determines what the output of the different sectors should be, given the final demand for consumption and investment. The plan also attempts to strike a balance between the total investment required for achieving a given rate of growth in income and the domestic savings that can be generated and the external aid. The total savings that are to be generated within the economy are themselves contingent upon the realization of the physical targets. Thus a plan emerges which matches a mutually consistent set of physical targets with a scheme of mobilization of financial resources based on the fulfilments of the physical targets. It is this consistency which is at the same time the strength and weakness of a plan. If all the targets are fulfilled this leads to the most efficient use of the resources. But if targets are not achieved, the entire balance is upset and can result in a considerable waste of resources.

The Indian plans in striking a balance between savings and investment or between the rates of growth of different sectors of the economy view the nation as a total entity, though the plans make a distinction between investment in the public sector and that in private sector. While the plan is spelt out in detail as far as the public sector investment is concerned, the investment to be made by the private sector and the production targets to be achieved by it are only 'indicated'. The desired amount and type of investment to be made by the private sector are sought to be achieved through the various policy instruments available to the government. These tools vary from direct controls such as licencing to the traditional instruments of monetary and fiscal policies.

Implications for Corporate Planning

The significance of the national plans for corporate planning is not the same for the enterprises in the public sector and those in the private

sector. In the case of public sector enterprises, the national plan incorporates the major expansions contemplated. The work of the corporate planner in these enterprises begins even as the national plan is being formulated. Their expansion plans have to be approved in the first stage by the ministry to which they are attached and later by the Planning Commission. In the case of new enterprises, the ministries and the Planning Commission become the 'promoters'. Therefore, in the discussions that follow, the primary focus will be on the implications of the national plan for the enterprises in the private sector, even though some of the issues raised are also relevant for the corporate planner in the public sector.

Informational Content of a Plan : In examining the environment, every firm is looking for opportunities in fields in which it has a distinctive competence. This exploration involves identifying the emerging new demands, assessing the technological developments that are likely to occur and estimating the possible actions by its competitors. The firm must also apprise the plans of other complementary enterprises such as those which supply inputs to it or absorb its output. In a decentralized decision-making system all this information can be gathered only imperfectly. It is from this point of view that the existence of national plan is of a great advantage. The purpose of drawing up plan is to indicate in very clear terms the directions in which the country must grow. The plan specifies the investment to be made in the various sectors. One may disagree with the strategy adopted by the Planning Commission, but once the plan is approved by the Government and the Parliament, it is a commitment as far as the government is concerned. It is a blue print for action. As mentioned earlier with respect to investment in the public sector, the plan provides not only the magnitude of total investment to be made in each sector but also the details of the specific projects to be undertaken in each sector. The plans of the government in various fields, so to say, become an open book and this is of considerable importance with the emergence of the government as the dominant investor. Thus, through the plan document, a firm obtains an idea of where the investment is considered to be desirable. In addition, it also knows where there is already a commitment in terms of investment on the part of the government. These two together must constitute a valuable set of information for any corporate planner. Obviously, the scope of activities of a firm in the private sector is limited when compared to the scope available in a purely capitalist system.

In so far as the state preempts part of the resources available and also specifies the areas in which it alone can enter, the scope for the private sector becomes limited. In fact, it is the Industrial Policy Resolution of the government which has attempted to delineate the areas in which each of these sectors is to operate. Each Five-Year Plan based on this, indicates broadly the industries in which the private sector can enter. The issue that is very often raised is not so much whether a firm in private sector can enter a particular field or not, but that whether some segment of the private sector such as the big industrial houses can enter it. It must be admitted that government's policy on this has not been steady. It has fluctuated between a 'severe' and a 'liberal' attitude. However, the plan as a whole tells what can be done and what cannot be done by the private sector. To the extent the investment in private sector is dovetailed to the investment in the public sector, the latter is readily available to it. In Table 1, an attempt is made to classify industries according to expected growth rates specified in the draft Fifth Plan document. It can be seen that while some industries are expected to grow only at about 4 percent per annum there are industries like fertilizers which are expected to grow at 28 percent per annum.

It is, however, worthwhile to note that the physical targets for output indicated in the plan for the various sectors and within the industrial sector for the various industries are largely aggregative in character. Targets set for, say, electric transformers need to be further broken up into transformers of different sizes. The Planning Commission, while arriving at these targets, has the help of study groups in which industry representatives are involved. The need to estimate the product mix within each broad category is a task that must be done by the individual firms. More recently the Ministry of Industrial Development has been publishing a document entitled 'Guidelines for Industries' which indicates the product-wise demand as well as the existing capacity and the current status of licences applied for addition to capacities. This is useful information. Nevertheless, the need for doing a more intensive analysis of the targets relative to individual products cannot be escaped. The broad aggregates given in the plan provide the necessary starting point.

Nature of the Targets : With respect to the targets indicated in the plan, there are two aspects which need careful examination. The targets set

for each industry grouping, for example, in the plan are in physical terms arrived at in order to establish a balance between inputs and outputs. Thus this balance results in a congruence between physical outputs and inputs. The targets set in the plan are, therefore, more like requirements than demand in the economic sense of the term. There is no attempt made on the part of the planners to indicate whether entering into a particular field would give the necessary return on investment. More recently, with respect to projects in the public sector, detailed analysis of cash flows is being done before they are incorporated in the plan. Obviously, the analysis is not confined to a private cost-benefit basis. The planner is much more interested in a social cost-benefit analysis. Private costs and benefits are suitably modified to take into account the opportunity costs to the society. Whether or not the targets fixed for the various industries would be fulfilled depends upon whether the firms in the private sector that enter the field would find it profitable. This is an aspect of the problem which the planners themselves would need to look into. It is pointless to fix targets for various industries if the fulfillment of such targets does not generate the required level of profitability.

While it may be fair for the planners to decide on what the appropriate level of profitability should be, enough attention should be paid to see whether pricing and other policies pursued would ensure this fair rate of returns. However, as of now the physical targets laid down in the plan must be treated by the firms in the private enterprise as output levels necessary, if all the sectors are to grow according to the plan.

We have emphasised repeatedly that an essential characteristic of our plans is their consistency. Output of one industry becomes the input of another industry, unless it is directly consumed. Thus, from the point of view of the economy as a whole, there should be a balance between the rates of growth of the various sectors if waste is to be avoided. Consistency in this sense is like the music produced by an orchestra where every instrument is to be so controlled that the total action results in harmony. As mentioned earlier, if all the targets are not simultaneously fulfilled, it will result not only in waste of resources but also put individual firms in considerable difficulty. The study groups appointed by the Planning Commission for various industries arrived at the total estimate of demand based on the assumption that the growth rates fixed for all the sectors of the economy would be

achieved. For example, the demand for tyres is based upon the estimate of originating traffic which again depends on the increase in agricultural and industrial output. A substantial fall in agricultural or industrial output can, therefore, have a very serious impact on the demand for tyres. Instances of serious shortfalls in the various sectors are not uncommon in our planning experience. In order to emphasize the gravity of the situation, we have provided in Table 2 the difference between targetted growth rates and the actual growth rates for a variety of industries during the Fourth Plan period. It shows that there are only four industries whose actual growth rates were equal to or better than the targetted growth rates. We have given in Table 3 the details of shortfalls in the fulfilment of capacity creation during the Fourth Plan period for approximately 24 industries. We have summarized the shortfalls in terms of certain categories of industries in Table 4. Output shortfalls can occur in any particular year due to a variety of factors, some of which can be purely temporary. A severe drought can result in a crippling power shortage which may have an effect on output. But persistent large shortfalls in output as compared to the targets must alert a corporate planner. It would be idle to pretend that the plan as enunciated would be maintained. It is unfortunate that the Planning Commission itself does not bring out at the time of mid-term appraisal revised sets of targets. Very often the mid-term appraisal is an exhortation to fulfil the targets than a serious effort to alter the targets themselves in the light of the experience in the first few years of a plan. It is, therefore, necessary for the individual firms to understand clearly the process by which targets have been arrived at and to make necessary alterations in their own calculations if some of the basic assumptions go wrong. This is a matter of importance not only to the firms in the private sector but also to those in the public sector.

Totality of a Plan

We have emphasized in the previous section on the nature of the interdependence among the targets set for the various industries and the need for understanding the consequence that results when the required balance is not maintained. This argument holds good with respect to the totality of the plan also. Income growth is linked to the level of required investment which, in turn, must be balanced with domestic savings and external assistance. Thus the fulfilment of a plan as a

whole depends on the fulfillment of a number of basic assumptions. At the time when the draft Fifth Plan came out, very serious doubts were expressed on various aspects of the plan. Those who thought that the plan was unrealistic raised the point that the physical targets laid down in the plan could not be fulfilled with the mobilization of resources contemplated. Some regarded that the targets with respect to savings were set too high and that they were not supported by past experience. Questions were also raised at that time on the calculations that had been made with respect to import requirements, doubting thereby the possibility of being able to reach the target of net zero aid at the end of the Fifth Plan. It is not our intention here to examine the various questions that had been raised. But, it is necessary for any corporate planner to examine these issues and form his own judgement regarding the feasibility of any given plan. Inability to implement the plan as originally contemplated would call for revisions which may have serious implications for the expansion plans of individual firms.

Conclusion

The concept of a mixed economy, as practised in India, by its very definition limits the area of operations of the private sector. But the national plan, viewing the economy as a whole both in terms of short run and the long run indicates the appropriate fields of development for the firms in the private sector as well. Depending on the vigour with which the policy instruments are used, these indications can become much more than mere expectations. However, the targets set in any plan for the various industries and sectors must be treated with some circumspection. This caution applies as much to industries in the public sector as they are to those in private sector. First of all, the targets set for various industry groupings are highly aggregative and therefore must be broken into productwise demand. Second, the implications of the physical targets laid down in the plan need to be translated into economic and financial terms to determine the profitability or otherwise of entering a particular field. Finally, the targets set for the various industries are highly interdependent and shortfalls in the output of some of the crucial sectors can completely upset the targets set for most of the industries. Our past plan experience quite clearly warns us to be on the guard on this score.

It is only legitimate that a corporate planner should treat the national plan as given and make his own schemes of expansion in that context. But at the same time, it is important for him to understand the strategy and assumptions underlying the national plan because that will enable him to quickly reassess the segment of the plan he is interested in, if some of the underlying assumptions go wrong. In this he might be even a few steps ahead of the national planners, if he is perceptive enough. Without doubt, the plan provides the broad framework within which the corporate planner can draw his own plans. But, in so doing, he cannot escape from making his own judgement on the key assumptions of the plan.

Table 1 : Classification of Sectors and Sub-sectors by Range of Rates of Growth of Gross Value Added (r) Over the Fifth Plan Period

Sl. No.	*Sectors/Sub-sectors*	*r*
	2—5%	
1	Food Products (Total)	4.78
2	Vegetable Oils	4.80
3	Tea and Coffee	3.47
4	Other Food Products	4.59
5	Textiles (Total)	4.10
6	Cotton Textiles	4.27
7	Jute Textiles	3.77
8	Other Textiles	4.79
9	Miscellaneous Textiles Products	3.76
10	Wood and Paper Products (Total)	4.93
11	Wood Products	4.58
12	Cosmetics and Drugs	4.64
13	Radios	2.03
	5—10%	
14	Petroleum Product	9.79
15	Mining and Manufacturing (Total)	8.11

Sl. No	Sectors/Sub-sectors	r
16	Mining (Total)	9.86
17	Iron Ore	8.87
18	Crude Petroleum	8.78
19	Other Minerals	8.79
20	Manufacturing (Total)	7.98
21	Sugar and Gur	5.70
22	Paper and Paper Products	7·70
23	Leather and Rubber Products (Total)	7.32
24	Leather Products	5.73
25	Rubber Products	8.41
26	Man-made fibres	5.61
27	Other Chemicals	8.71
28	Coal and Petroleum Products	6.87
29	Non-metallic Mineral Products (Total)	8.20
30	Cement	8.89
31	Other non-metalic Mineral Products (Total)	7.96
32	Metal Products (Total)	8.64
33	Bolts and Nuts	9.89
34	Metal Containers	6.58
35	Other Metallic Products	8.67
36	Agricultural Implements	8.03
37	Electrical Engineering Products (Total)	8.91
38	Electrical Motors	9.83
39	Electrical Wires	8.90
40	Batteries	7.74
41	Electrical Household Goods	6.73
42	Transport equipment	7.24
43	Motor Cycles	6.90
44	Motor Vehicles	5.97
45	Ships and Boats	9.65
46	Railway Equipment	7.47
47	Other Transport Equipment	6.63
48	Instruments (Total)	8.20
49	Watches and Clocks	7.84
50	Miscellaneous Scientific Instruments	8.37
51	Miscellaneous Industries	8.41
52	Printing	5.20
53	Electricity	9.87

Sl. No.	*Sectors/Sub-sectors*	*r*
54	Construction	8.70
55	Transport (Total)	8.70
56	Transport Railways	5.73
57	Other Transport	5.55
58	Services	5.65
	10—15%	
59	Coal	10.63
60	Chemical Products (Total)	12.35
61	Inorganic Heavy Chemicals	13.54
62	Organic Heavy Chemicals	10.65
63	Plastice and Paints	10.19
64	Miscellaneous Coal Products	12.14
65	Refractories	10.44
66	Basic Metals (Total)	11.76
67	Iron and Steel	10.78
68	Non-ferrous Metals	14.90
69	Non-electrical Engineering Products (Total)	13.56
70	Ball Bearings	14.53
71	Office and Domestic Equipment	10.86
72	Other Machinery	14.59
73	Electronics	11.60
74	Telephone and Telegraphic Equipments	10.02
75	Other Electricals	12.08
76	Aircraft	11.06
	More than 15%	
77	Fertilizers	27.69
78	Machine Tools	15.91
	All Sectors	5.50

Source :— Draft Fifth Five-Year Plan 1974-1979; Vol. 1; pp 34-35.

Sl. No.	Industry	W_i	r	r'	D (r'−r)	D as % of r
20—40% underfulfilment						
46	Motorcycles, Scooters Mopeds	0.8200	19.66	14.86	—4 80	—24.4
47	Crude Petroleum	0.3910	7.00	5.12	—1.88	—26.8
48	Cement	1.1700	8.09	6.00	—2.09	—25.8
49	Aluminium	0.5700	11.91	8.80	—3.11	—26.1
50	Automobile tyres	1.1880	9.86	7.19	—2.67	—27.1
51	Caustic Soda	0.1699	10.46	7.50	—2.96	—28.2
52	Soda Ash	0.1324	6.31	4.93	—1.38	—21.8
53	Nylon Filament and Staple	0.0009	34.86	21.57	—13.29	—38.1
54	Wireless and Microwave Equipment	0.0002	20.84	12.74	- 8.10	—38.1
55	Paper and Pulp Machinery	0.0009	37.97	23.00	—14.97	—39.4
56	Diesel Locomotives	0.8340	17.52	12.83	—4.69	—26.7
	Total Index	5.0773	11.854	8.757	—3.097	—26.173
0—20% underfulfilment						
57	Vanaspathi	1.0900	6.05	5.67	—0.38	—6.3
58	Paper and Paper Board	1.6100	5.62	5.56	—0.06	—1.1
59	Electric Fans	0.4110	15.16	13.67	—1.49	—9.8
	Total Index	3.1110	7.031	6.669	—0.361	—4.071
% overfulfilment						
60	Oxygen Gas	0.1140	7.77	14.97	+7.20	+93.5
61	Tool, Alloy and Special Steel	10.1170	32.61	74.64	+36.03	+93.3
62	Dry Batteries	0.1870	6.57	9.69	+3.12	+47.4
63	Sugar Mill Machinery	0.1440	13.44	+14.3	+0.59	+4.4
	Total Index	0.5620	15.244	25.395	+10.151	+55.29

Note : W_i = Value added proportions as used in the official series of Index of Industrial Production.
r = Planned growth rate during fourth plan period (1969-70 to 1972-73).
r' = Achieved growth rate during fourth plan period (1969-70 to 1972-73).

Source : Draft Fifth Five-Year Plan 1974-1979, Vol. 1; pp 38—40 and Vol. II pp. 156—159

Table 3: Extent of Fulfilment of Capacity Targets During Fourth Five-Year Plan Period

Sl. No.	Industry	W_i	r	r'	D $(r'-r)$	D as % of r
More than 100 „ underfulfilment						
1	B. H. C.	0.0388	11.17	—2.12	—13.29	—118.9
2	Zinc	0.0054	14.86	0	—14.86	—100.0
	Total Index	0.0442	11.62	—1.86	—13.48	—116.6
70—100% underfulfilment						
3	Phosphatic Fertilizers	0.1200	23.30	5.87	—17.43	—74.8
4	Pig Iron For Sale	0.1300	28.47	6.58	—21.89	—76.8
5	Sulphuric Acid	0.0098	16.05	3.21	—12.84	—80.0
6	Metallurgical and other Equipment	0.0410	6.23	1.15	—5.08	—81.5
	Total Index	0.3008	22.97	5.45	—17.52	—76.4
40—70% underfulfilment						
7	Newsprint	0.0800	40.63	20.11	—20.52	—50.5
8	Mild Steel (Finished Steel)	3.8000	5.46	3.26	—2.20	—40.2
9	Steel Ingots	0.100	5.92	3.33	—2.59	—43.7
10	D. D. T.	0.1116	23.36	8.45	—14.91	—63.8
	Total Index	4.0016	6.66	3 74	—2.92	—41.07
20—40% underfulfilment						
11	Petroleum Products (and Lubricants)	1.3400	9.85	6.52	—3.33	—33.8
12	Nitrogenous Fertilizers	0.3360	23.98	17.40	—6.58	—27.4
13	Aluminium	0.5700	14.47	10.76	—3.71	—25.6
14	Agricultural Tractors	0.0050	27.73	18.64	—9.09	—32.7
15	Caustic Soda	0.1699	6.96	5.31	—1.65	—23.7
16	Thermal Turbines	0.0500	22.46	15.74	—6.72	—29.9
17	Coal and Other Mining Machinery	0.0130	9.85	7.71	—2.14	—21.7
	Total Index	2.4839	12.91	9.10	—3.81	—30.2

Sl. No.	Industry	W_i	r	r'	D (r'—r)	D as % of r
Less than 20% underfulfilment						
18	Paper and Pulp Machinery	0.0009	19.91	16.53	—3.38	—16.9
19	Soda Ash	0.1324	8.61	7.52	—1.09	—12.6
20	Hydro Turbines	0.0500	27.73	22.87	—4.86	—17.5
	Total Index	0.1833	13.88	11.75	—2.13	—13.9
% underfulfilment						
21	Tool Alloy and Special Steel	0.1170	37.97	55.18	+17.21	+45.3
22	Copper	0.0800	37.68	42.80	+5.12	+13.6
23	Power Tillers	0.0025	87.76	88.82	+1.06	+1.2
24	Machine Tools	0.3865	8.73	13.70	+4.97	+56.9
	Total Index	0.5860	18.86	26.27	+7.42	+48.4

Table 4 : Capacity Fulfilment According to Types of Industry

Sl. No.	Industry		W_i	r	r'	D (r'—r)	D as % of r
1	Capital Goods	8	0.5489 (7.2)	12.10	14.03	+1.93	+28.8
2	Basic Industries	5	4.5854 (60.3)	7.81	4.97	—2.83	—38.5
3	Intermediate Goods	5	2.4655 (32.4)	15.14	10.62	—4.52	—32.8
	All Industries	24	7.5998 (100.0)	10.50	7.46	—3.03	—31.8

Notes : W_i = Value added proportions as used in the official series of index of industrial production.

r = Planned growth rate of capacity during fourth plan period (1969-70 to 1972-73)

r' = achieved growth rate of capacity during fourth plan period (1969-70 to 1972-73).

Source : Same as in Table 2

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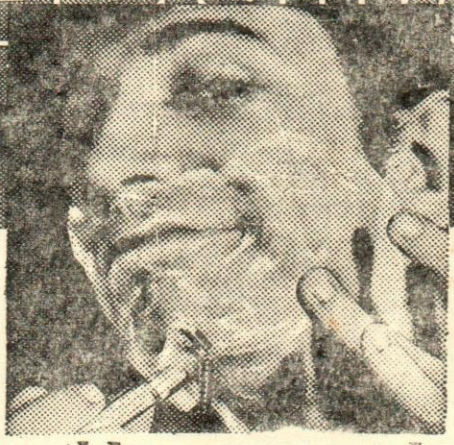

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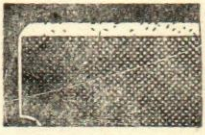

(Magnified view) Ordinary blades have a raw, naked edge. They cut your skin along with your beard.



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LINTAS-ESB. 3-1

Corporate Planning and National Policies

C. N. S. Nambudiri

The focus of this paper is on the inter-relationship between corporate planning at the level of the industrial organizations, and national policies that are of direct relevance to that task. Corporate planning is often distinguished separately into corporate strategic planning and operational planning. Corporate strategic planning leads to the formulation of the strategy of a corporation or the matching of an opportunity in the environment, with the specific profile of resources, skills and competence of the firm, in consonance with the values of those who direct the enterprise. Strategy provides a long-term direction for the pattern of deployment of resources. It is achieved through operational planning, which identifies the tasks to be done and the specific resource requirements for them. When these tasks are carried out well, it accomplishes the organizational purpose indicated by the strategy. The inter-relationship between corporate planning and national policies extends to both strategic choice as well as its accomplishment through operational planning.

National policies form an element of the environment in which both strategic choice as well as operational planning are carried out. The policies, as an element of the environment, also affect performance of these tasks. National policies may be defined as guidelines for administrators in government, for taking operational decisions. Policies, whether in corporations or the government, are laid down to ensure that the wide range of decisions that have to be made in order to achieve corporate or national objectives are, in fact, made and are in line with such objectives. Their use permit degrees of discretion in taking into account the situational factors immediately concerning individual circumstances requiring decision. Policies, therefore, do not have a standing by themselves, but are useful only in conjunction with the objectives and the overall direction in which the company or the country is moving. Policies, along with plans, objectives and an overall concept of national interest, constitute a national strategy. An illustrative presentation of the concept of national strategy is given here. The implication is that national policies have to be

understood in the overall context in which they have been formulated. This article will, therefore, treat policies in the perspective of the national strategy that gives rise to them.

The Concept of National Strategy

(A) Concept of national interest : The concept of national interest "is a conception of the nation and its future" that is explicitly stated or implicit in its actions, planning processes, and plans or policies adopted.

The concept may best be illustrated with the following examples drawn from the plan documents of several countries.

(a) "French planning is the search for a middle way, reconciling one's attachment to liberty and individual initiative with the common orientation of development."[1]

(b) "All long-term decisions rest on conception of the future. But it is clear that the market does not provide this conception." French national planning is said to have been designed to supplement the market mechanism, not to replace it."[2]

(c) "Development along socialist lines to secure rapid economic growth and expansion of employment, reduction of disparities in income and wealth, prevention of concentration of economic power and creation of value and attitudes of a free and equal society."[3]

(d) "The basic objective of planning in Nigeria is not merely to accelerate the rate of economic growth and the rate at which the level of living of the population can be raised; it is also to give her an increasing measure of control over her own destiny."[4]

(B) Objectives: Objectives set out not only the broad economic and social development priorities, but also the standards of performance sought to be achieved, overall and in the different sectors of development through the utilization of the national resources. These standards of performance may be described using several parameters, such as the growth rate of gross domestic product, per capital income,

gross domestic capital formation, etc.

(a) "The highest possible priority was accorded this endeavour in order to establish the competitive capacity of French industry in the world. To this end, elements of an explicit industrial developmental strategy were elaborated in the Fifth Plan."[5]

The Fifth Plan also brought out for the first time, a package of options. These targets for the plan were as follows : Gross National Product 5 percent, Personal Consumption 4.5 percent, Productive investments 5·8 percent and Public investments 8.2 percent.[6]

(b) "An outstanding feature of the Fourth Plan is that it places a very conspicuous and oft-repeated emphasis on the common man, the weaker sections and the less privileged. It is laid down by the Commission, "that planning should result in greater equality in income and wealth and that benefits of development should accrue more and more to the relatively less privileged classes of society."[7]

This was clearly an expression of a social objective and its priority in no uncertain terms.

(c) The Fourth Five-Year Plan also laid down clear performance standards in some key sectors : growth rate in agricultural output at the rate of 5 percent per year, growth of exports at 7 percent per year, and a reduction of net aids to 50 percent of their existing levels by 1974.[8]

(d) The National Development Plan (1962-68), in Nigeria, gave the highest priority to agriculture, industry, social development and the development of infrastructure facilities. It is also stated that the development of a broadbased and progressive private sector as part of a mixed economy was one of the major objectives. The plan laid down a growth rate of the economy of 4 percent per annum, to keep the increase in the average rate of private consumption at 3 percent per year, and to provide 15 percent of the Gross Domestic Product for investments to achieve the deserved growth rate.[9]

(C) *The Plans :* Plans are the end result of the national economic planning process. In its final form it spells out action programmes, tasks and targets to be achieved, through the allocation of

resources. The national plans are almost invariably described in terms of public and private investment programmes in the different sectors. It also includes the available sources and the means by which they are collected. Plans represent a translation of the objectives, into a concrete deployment of financial and other resources into action programmes.

(D) Policies : Policies are guidelines for action, useful and necessary in achieving the plan objectives, in particular, and in reaching concepts of national interest underlying them.

Many examples of policy components of national strategy are identifiable in the plan documents. Thus in the Fifth Plan (France) there was a clearly enumerated energy policy.[10]

A clear policy guideline has existed in the successive five-year plans (in India) for public agencies in organizing the passing on of the results of research in agriculture to the farmers.[11] The National Development Plan 1962-68 (Nigeria), had a policy guideline for the preparation for project proposals. The policy required the proposals to be checked for feasibility and internal consistency with the development of a private sector.[12]

(E) Implementing decisions : All plans are implemented through decisions. Although many thousands of decisions are taken, some of these have certainly more far-reaching consequences than others. These are 'strategic' in as far as they affect the working of a whole sector or sectors of the economy and the corporations operating within them. The analysis of the environment of a corporation will not be complete without adequate recognition of the significance of decisions taken in the past or currently.

Interdependance of Corporate Plans and National Plans

The interrelationship between corporate planning and national policies are of the utmost significance in planned, mixed economies. This significance arises from the fact that many of the objective and plans of the national strategy is sought to be implemented through the performance of the corporate sector. Naturally, in such economies, corporate plans of industrial organizations are very much dependent on the national

plans. Corporations, and, in particular, industrial corporations, whether in the private or the public sector, are organizations where specialised and often unique combinations of resources—technological and organizational have been developed. They have, by this unique combination developed, the ability to contribute to the tasks of economic development. This unique capability to contribute not just to the pockets of the owners of the business or the state treasury—but to the ends of national economic development is what makes the governments of developing countries eager to direct and influence them. Corporations in a sense have become key toois of economic development. National policies are means by which these corporations are guided in contributing to the overall tasks of national development. Therefore, their availability wherever necessary, their consistency to the overall objectives of the national strategy, the internal consistency among the various policies and the way in which they are used can have significant impact on the work of the corporations.

The state influences the corporations through its policies for an industry. Each major industry is influenced by a set of sectoral policies. These have their impact on all the corporations in that industry. The corporation is also influenced more directly, for example, by the licensing policies where the size and position of the company in the industry and other factors are also taken into account. Several institutions, established by the State extend the influence on corporations, through their own policies. Examples are provided by the nationalised banks and other institutions established to support and develop industrial corporations. The sectoral policies and the institutional policies and their influence is certainly, in addition to the fiscal and monetary policies that are applied to the entire economy. The policy framework emerging out of all these form the politico-economic environment within which the corporate planner formulates strategic choices as well as corporate plans. Therefore, a clear perception of the policy framework and its implications for the firm in terms of the choice of alternatives for the future is an essential starting point for the corporate planning process. It is here that an explicit statement, and a systematic analysis of the overall concept of national interest, the objectives, plans, policies and implementing decisions, as it affects the sector in which the corporation operates is likely to be most useful for the corporate planner. The concept of national strategy, illustrated earlier, is an attempt to provide a systematic frame for the corporate planner to islolate the policy framework in its

total perspective, and realise the implications for this task.

Evolving a Corporate Plan on the Basis of National Priorities

It has heen fairly well accepted by corporations in many countries, that corporate planning is helped substantially by the national plans developed by national economic planning.[13] One of the ways in which corporate planning is helped is the way national plans spell out national priorities in the fields of economic and social deveiopment. These priorities reduce the task of scanning the environment in the corporate planning processes, by mapping out a time horizon spectrum of a matrix of opportunities likely to be available to the enterprsie.

Strategic choices and operational planning in corporations are based on several basic assumptions about the likely state of the environment. If these judgemental assumptions do not come true in the course of the time horizon, many of the expected results of the operational plans, and therefore, the benefits of strategic choices are unlikely to materialise. The weight of the State's massive allocation of resources in the national plans and its projects, provides substantial certainty to the assumptions on which the corporations can make their own plans. The magnitude of the State's role in the plans for economic development in developing countries tends to add further to the certainty underlying the assumptions. National plans thus aid not only in the identification of opportunities likely to be available, but also provide a degree of certainty for making assumptions about what is likely to happen.

The commitment of the state's resources in many of the plan projects further serve to indicate clearly the nature and magnitude of opportunities. Thus where the state is committed to put up a major power generation project, the nature of opportunities available to transformer, cable and other manufacturers is clearly indicated. Where national policies have created public sector industries in key and strategic areas, the corporate plans of such organisations form part of the national plans. The plans of many other corporations become linked or dependent on the plans of these corporations. The plans of the larger corporations in turn become the basic assumptions underlying the plans of smaller organizations In this way national plans produce chains of linkages amongst the industrial organizations in the country. The basic assumptions underlying these linked plans are no doubt

supported by other and more general assumptions about the environment and its future in each company's corporate plans. In our economy it is easy to recognize many of these linked systems, each traceable to a single major national objective set out in the national plan. The plan to build a single major power source can be easily visualised as a system of linkages amongst cable, transformer and motor manufacturing units. Each such linked system is a string of corporate strategic and operational choices of many firms, differing in size, and in the degree of importance to the firms concerned.

Impact of National Policies on Strategic Choices and Operational Tasks of Corporations

While the national plans thus aid in strategic choice, the national policies determine, to a considerable extent, the nature of the environment in which the strategic choices are accomplished through operational tasks of corporations. National policies have to provide the stability, that can make the assumptions underlying the corporate plans hold true. While the power to provide that stability may not always be within the complete control of those formulating national policies, it should be and is their endeavour to provide such stability as is within their control. Too frequent and drastic changes in policies can change many of the basic assumption underlying corporate plans and therefore affect their achievement. When the corporate plan of a large number of corporations are affected, it might seriously affect the achievement of not only corporate objectives, but also the targets of the national plan itself due to the nature of interlinks that exist in a mixed economy between national plans and corporate plans. Thus, one of the over-riding roles of national policies in relation to corporate planning is to provide the stability of the environment, that will hold the basic assumptions on which corporate plans are built, true as far as humanly possible. Providing stable conditions in itself, therefore, becomes a major national policy in economic development. Almost every other policy developed by the country, needs to be consistent as far as possible with this keynote policy.

While stability of policies is extremely desirable, it must be realised, that there are factors that bring about the need to reformulate policies, Some of these factors lie outside the national system, and, in turn, indi-

cates the highly interdependent nature of the world economy today. Situations within the country can also make policy review essential. It must be remembered that in the national objectives of a country, there are both economic as well as social priorities. Shifts in relative importance amongst these priorities are often triggered off by events within and outside the country. These shifts would have an effect on some of the policies. Therefore, contingency planning would have to be deveioped to cope with such shifts in national policies.

Need for Stability and Consistency of Policies

The need for stability of policies as well as the need for speedy revision of policies is nowhere more clearly observable than in the area of corporate plans for exports. The need and desirability of increasing exports in our national situations needs little elaboration here. The exports of a corporation to several countries in the world are subject to the diverse economic policies and conditions prevailing in those countries, which tend to change. Therefore, a corporation's plans for export are subject to potential changes. In operating these plans, a certain stability in national policies supportive of exporrs is, therefore, all the more necessary, over a fairly long period of time. At the same time, sudden major changes in large markets in the world, will require major revisions in policies governing exports to such markets. Delay in revamping policies in this area would significantly affect the performance of plans of corporations. Consistency amongst policies formulated was pointed out as a desirable characteristic. Since a large number of agencies of the government are involved in formulating policies, affecting their areas of operation, there is a conscious need for ensuring consistency amongst policies so created. Inconsistency amongst policies also arise as policies are made to achieve economic as well as social ends. Such inconsistencies in key areas have to be resolved by appropriate changes in the poilcies concerned or in the way in which such policies are interpreted and used as guidelines. Resolution of such conflicts can olny be done with reference to the spirit of the objectives or even the concept of national interest. An example might serve to illustrate this point. National policies encourage corporations to go into permitted areas of economic activity. Policies also direct the penalisation of those guilty of economic crimes. A corporation, alleged to be guilty of an economic crime

removed, unless the need for doing so is brought out, strongly and clearly.

The foregoing discussion of national policies from the point of view of corporate planning brings up several areas for study and action on the part of organisations, institutions, and individuals involved. The importance of participation of officials, entrepreneurs and other groups has been repeatedly emphasised by the experience of implementations of plans.[16] It would seem reasonable to suggest that participation of such people would be more fruitful at the policy making level, since appropriate policies can cover a large number of decisions. The complexity of the policy framework that is needed to govern the industrial organisations today in developing countries, also makes it necessary that different points of view are brought together in the policy making process. The complexity arises from the number and variety of industries, their differing requirements of success, the priorities of economic and social development objectives that have to be met and the social situation within which the policies have to be interpreted and implemented.

Therefore, there seems to be a need to bring related knowledge and experience from three distinct points of view, viz., those of the economic and social objectives to be achieved, those of the organizations likely to be affected by the policy, and finally, that of the interpreter and implementor of policy. The experience of planning in many countries shows that this pooling together of knowledge and experience in formulating policy is seldom achieved. A United Nations study on Planning and Implementation' observes that : "the policy makers quite often do not participate sufficiently in the planning process, prefering to leave this to planning experts. The experts then perform the functions that should be performed by policy makers. As a result, the plan may become a document representing expert opinions rather than policy choices. Consequently, policy tends to develop along its own lines without availing itself of the advantages presented by planning."[17] The knowledge of the possible impact of policies on corporations is very often absent do to the inadequate participation of the leaders of industry and their failure to distinguish between the roles of influencing desirable policy choices and presenting immediate industry problems. The above study has also pointed out the need for the policy interpreter and administrator to have a clear understanding of the overall strategy and

its implications, in facilitating his task. The task of implementing overall national plans is further hampered by the conditions under which they have generally to be implemented—"the main administrative problem of plan implementation was the fact that the basic legislation in force in many countries had been drafted before the idea of economic planning had come to force.[19]

It will be realised, therefore, that the skills of influencing corporations, through appropriate and well-formulated policies, to contribute to national goals is perhaps just as essential as the skills of successful direction of enterprises, to make the relationship between national policies and corporate planning a positive and functional one. The successful direction of an enterprise in its environment has been attributed, to a large extent, to its ability to influence the environmet. It would seem appropriate that corporations adopt a wider definition of the environment to include the framework of policies within which they operate. The chief executives of corporations and the corporate planners who work with them have, therefore, to play a wider role. The chief executive, knowledgeable about his industry, can best provide a scenario of the possible impact of policies on corporations. The corporate planner would not only have to understand and act within the policy framework already existing, but also see how and in what way policies could be more desirable and how the formulation of such policies could be influenced.

The skills of influencing corporations and influencing policy formulation are complex skills, and as such their development should not be left to mere chance, but should be undertaken systematically. The acquisition as well as the effective exercise of these skills is possible only in an atmosphere of mutual trust and co-operation. Trust and co-operation can develop only through a commonness of purpose and a common dialogue. In a programme for a group of senior civil servants primarily concerned with formulation and interpretatation of policy on industrial corporations, one of the participants brought in his experience of participating as a cost accountant in an exercise that led to the introduction of price control on the product of a company. It was the only manufacturer of that product in the country. The company's annual production as well as installed capacity were more than adequate to meet the country's needs, at that time. With a protective tariff and or a ban on imports, the company had a monopoly situation in the national market. An analysis of the history of the project which led to the

establishment of the company and its financial performance since then, showed that the company had not been able to provide, even a reasonable return on investment for the shareholders. *Prima facie*, it appeared that price control, at a level lower than what was prevailing, was likely to put the corporation on the sure road to more losses and ultimately liquidation. Such a course. it was agreed, would lead to the wastage of considerable and valued organization and technological skills and resources that had been built up in the corporation. This is typical of a situation where the policy makers and interpreters of policy work in the absence of adequate knowledge of the impact of policy on a corporation, and its consequences in general. What policymakers, interpreters of policy and managers of enterprise have to realise is their common interest in preserving, developing and fostering the organizational and technological expertise that had been developed within these corporate organisations. Working together in these areas of common intrest, with understanding and co-operation needs a common dialogue between policy makers and the leaders of enterprises. It is this dialogue that can make national policies and corporate planning mutually supporting.

Notes and References

1. Industrial Planning in France, Johan H. Mc. Arthure and Bruce R. Scott, Division of Research, Graduate School of Business Administration, Harward University, Boston. 1969 P. 81.

2. Op. cit. p. 82.
Objectives and Policy Frame of the Fourth Indian Plan, An Appraisal.

3. Dr. B. S. Minhas in The Crisis in Planning, Volume Two, The Experience, M. Faber and D. Seers (Eds.) Chatto & Windus Ltd. Press, London for Sussex University Press, 1972 P. 21.

4. Federation of Nigeria.
National Development Plan, 1962-1968, The Federal Ministry of Economic Development, Lagos, P. 9.

5. op. cit. 1, p. 53

6. op. cit. 1, p. 99

7. op. cit. 3, p. 46

8. op. cit. 3, p. 28

9. op. cit. 4, p. 23

10. op cit. 1, p. 342

11. op. cit. 3, p. 31

12. op. cit. 4, p. 13

13. Corporate Planning Practices in Private Sector Companies in India, C. N. S. Nambudiri, *Indian Management*, June 1974.

14. The Lessons of Experience : Asia, D. P. S. N. Prasad, in The Crisis in Planning, op. cit. 3, p. 84.

15. op. cit 3, p. 23.

16. Policies of Plan Implementation (with special reference to Latin America) Report on the Third Interregional Seminar on Development Planning, Santiago, Chile, 18-29 March, 1968. United Nations, New York, 1970, p. 59.

17. Planning and Implementation, Committee for Development Planning, Santiago, Chile. 10 to 12 April, 1967, United Nations, New York, 1967, p. 5.

18. op. cit. 16, p. 15.

19. op. cit. p. 15.

Measuring the Need for Corporate Planning : An Operational Framework

S. K. Chakraborty

Those managers who often argue that in 'rapidly' changing Indian conditions it is nearly impossible to plan, may also agree with the point that nearly stable and unchanging conditions do not need systematic planning either. If one turns to the history of the erst-while managing agency houses, which had nearly a century of fairly placid atmosphere around themselves, one is unlikely to find any comprehensive, integrated corporate planning approach. The general pattern of growth in such houses was by grabbing whatever business came their way. Each venture was usually assessed independently of the rest, based on its own payback and return prospects. Thus, the 'ability' to plan, and the 'need' to plan should be viewed separately. It is our belief that if the true nature and significance of the underlying needs for formalised planning are appreciated, much of the force in the 'inability' or 'impossibility' argument will dissipate. It may then appear that it is precisely the changing conditions that call for organised planning (both short and long range). This paper provides a preliminary framework for assessing the degree of corporate planning need within an enterprise. It will be based on informed, data-based analysis of certain objective factors.

Factors Governing Corporate Planning Need

The following list of factors is suggested for consideration :

I. Degree of 'Derived' Demand for the Firm's Product or Service : The demand for car paints or car batteries is derived from the demand for cars. The demand for sheet metal for car bodies is also a derivative of car sales. The demand for machine tools is dependent upon the demand for goods produced by engineering firms using such tools. Firms selling goods directly to the general population, e.g., tea, bread, refrigerators, fans etc., on the other hand, have a relatively small degree of derived demand (in the sense that the householder's spending budget is directly there behind such demand). Greater the extent of derived demand, greater is the likelihood of fluctuating earnings. Thus, more conscious

planning will be needed to maintain earnings stability. An operational measure of the extent of derived demand for existing firms could be :

$$\text{(a)} \quad \frac{\text{(Highest Sales—Lowest Sales) during, say, last 5 years}}{\text{Average Sales over, say, past 5 years}} \times 100$$

Or, (b) (Highest Capital Turnover Ratio—Lowest Capital Turnover Ratio) ÷ Average Capital Turnover Ratio, during say last 5 years, assuming gross block to remain by and large stable.

Greater the percentage in (a), or larger the ratio in (b), higher should be the need for deliberate planning. It should be emphasised, however, that derived demand is a special and important case in the general phenomenon of relatively highly fluctuating demand. Either of the two indices may be used to assess variable demand. However, more sophisticated methods like standard deviation or coefficient of variation of earnings may also be used.

Both the indicators (a) and (b) are converted into a five point scale for measurement. As for (a), barring exceptional cases, the ratio should normally be less than 1. Accordingly the scale could be :

0.0 to 0.2	0·21 to 0·40	0·41 to 0·60	0.61 to 0·80	0.81 and above

In the case of (b) too, the value of the ratio should usually be less than 1. Hence, a scale similar to that for (a) should be adequate.

II. Degree of 'Depth of Processing' Engaged in by a Firm : With more processing stages is associated the fact of greater value added to the original input. Greater the margin of sophistication between the initial input and the final output that is sold, more is likely to be the need for integrated and wide-spanned planning covering the whole sequence. In many situations, e.g. in steel companies, this depth of processing may also imply the extent of vertical integration.

If the industry concerned is identified by the final product sold (no matter from which stage of conversion individual firms within it begin), then the following operational measures for measuring depth of process-

porate planning is 'impersonal' and market-determined. For those which are in the duopoly/oligopoly group, (e.g., automobile batteries) and not concerned with the basic or infrastructural items for industrial development, the urge for corporate planning is likely to arise from the need for inter-firm understanding for common weal. In firms which are concerned with basic inputs for the country's economic development, e.g., steel, power-generating equipment, etc., the emphasis on corporate planning tends to derive from national priorities and plans. There is no external market pressure as such, or a question of mutual survival either, which could be the primary cause for corporate planning as, say, in cosmetics.

For the purpose of the present study, only those firms for whom the pressure of impersonal market forces, emerging through competition, is the *causa-proxima* for corporate planning are considered. Accordingly, a competition-based scale of corporate planning need, in the context of this article, would attach a low-level need for duopoly/oligopoly/basic industry firms. No doubt the latter could have high corporate planning needs from their respective special standpoints as mentioned in the previous paragraph. As to the scale for measurement, we may begin with six firms at least (upto five being considered as oligopoly) as indicating the start of a competitive situation. Hence the following scale :

6 to 10 firms	11 to 15	16 to 20	21 to 25	25 and above.

This factor of competition could be applied to service industries like management consultancy firms, computer ware organisations, audit and taxation firms, and the like.

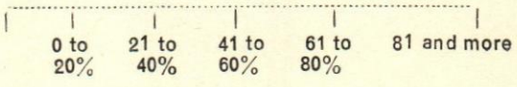
ing may be suggested :

(a) $\frac{\text{Value added}}{\text{Sales}} \times 100$, (where Value Added is Sales—Cost of Materials consumed in Sales) ;

or (b) Simply by expressing the number of processing stages actually gone through by a firm as a percentage of the total number of processes that could be gone through with the given production technology for a given end-product.

It will be noted that the second index mentioned above applies only to organisations producing and selling goods, and not to service organisations. This is largely true also of the derived demand factor stated earlier. Unless stated otherwise, the subsequent parameters will apply to both goods producing and service selling firms.

To convert indicator (a) to a five-point scale we should note that this index will not exceed 1. So the scale should look as follows :

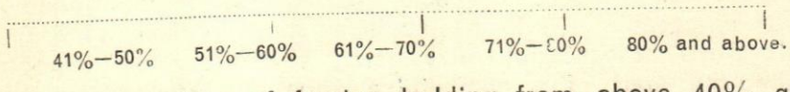


For (b), too, a similar scale could be framed.

III. Degree of 'Competition' Faced by a Firm : One common and readily understood means for judging the extent of competition (in the product market) is to take a census of the number of units functioning in the concerned industry. In India, for example, the bread-making industry is highly competitive, while the automobile industry has very little competition. In fact, the car, bus and truck manufacturing industries face an oligopoly situation. Besides, the country being large in size, one finds that the three car manufacturers [illegible]

finance. The choice sectors of investment has to be carefully made. For, here too the government has defined the areas or sectors into which a foreign firm may enter, e.g., the core sector, or foreign exchange earning sector, or backward and priority sectors. These defined possibilities have to be matched against the firm's present competencies, and its feasible potential strengths. Then again, the question of constituting the new business as a division of the existing company, or as a new company has to be faced and answered through comprehensive analysis. The example of I.T.C. Ltd. diversifying into hotel and deep-sea fishing business indicates the kind of corporate planning which is based on analysis of strengths and weaknesses as existing in the cigarettes business *vis-a-vis* those that would be relevant to the new lines of activity that might have been undertaken. Brooke Bond India Ltd., is similarly, diversifying into corned beef manufacture and exports.

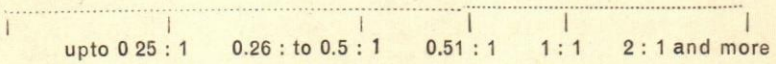
The government's present thinking is to bring all foreign equity shareholdings to 40 per cent of total equity over a reasonable period. A suggested scale for quantifying the need for corporate planning may, therefore, be as follows :



Greater the percentage of foreign holding from above 40%, greater should be the need for deliberate planning.

V. Dependence on Institutional Finance : With increasing inflow of finance from financial institutions like the IDBI, IFCI, ICICI, LIC and UTI, fundamental changes in management methods are likely to come about. These institutions seem to have been given a tacit responsibility for [illegible] about healthy and effective management practices in the aid-[illegible] the convertibility (into equity) clause being

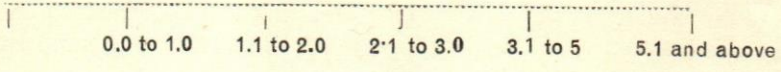
planning within the enterprise. (In passing, the request by several public sector enterprises to reduce their existing debt/equity ratios may seem to be one way of trying to escape the rigour of financial planning by taking shelter under the non-mandatory return-bearing equity capital—both dividend and principal sum-wise). In effect, we may say that in India the extent of dependence on financial institutions would be reflected through the debt/equity ratio (where debt includes long-term debt only) itself, because almost the whole of term-loans is today obtained from financial institutions or nationalised banks. The suggested scale for operationally measuring the dependence on financial institutions is, therefore, as follows (in terms of debt/equity ratio) :



We have started with only 0.25 : 1 since the Reserve Bank of India studies on the finances of medium and large scale public limited private sector companies (paid up capital of Rs. 5 lacs and above) have recently shown the debt/equity ratio to be less than 0·40 : 1.

VI. The Degree of Capital Intensity in the Enterprise : The more capital intensive a firm's product lines are, the higher are likely to be the compulsions of technological planning in various dimensions. For example, maintenance of plant and machinery, ensuring the supply of power to keep equipment running, availability of balancing equipment, provision of adequate skilled workers and supervisory staff for getting the best out of capital, production scheduling and planning after taking care of bottleneck points and so on, are a function of greater capital intensity. In a relatively labour intensive firm too, the planning need may exist. But then this will have a different focus altogether. In the latter situation planning effort should be concentrated more in ensuring the supply of required tools and materials in right time to a relatively large work force, and on monitoring their work. There will be a comparatively strong need in labour intensive firms to maintain a continuing atmosphere of strong motivation in the human resource. Although in a very broad sense efforts in this direction may also come under corporate planning, we shall, for the purposes of this article, consider the more formalised and structured aspects of corporate planning coming into play in more capital intensive firms only. Higher the capital intensity, greater is the likelihood of such planning tools/techniques being needed. As

an operational indicator of the degree of capital intensity, the ratio of 'gross block employed to total number of employees may be used. Although this is the most direct measure of capital intensity, the difficulty of easy access to this statistics on an across-the-industry basis is likely to hamper its use.* As a substitute one may use the 'capital/output' ratio, where capital could again be defined as gross block, and output as the gross sales value (at current prices) of output at *full* capacity utilisation of the plant. Or, better still, the output may be computed as a 'value added' figure by deducting from the sale value obtained above the raw materials and other outside items bought for producing the quantity sold at full capacity. The reason for using full capacity output is to obviate distortions in the capital-output ratio due to various degrees of underutilised capacity in different firms and industries. The scale to be used for the 'capital-output' ratio indicator of capital intensity is then as follows :



It should be mentioned that although 'gross block' is a better figure than 'net block', yet the former is unable to fully answer the question of inflation affecting the value of gross block depending on when the firm was established. (e.g., TISCO or IISCO vs. HSL). Some further adjustments may be useful in such cases.

VII. Link with the Ultimate Customer : One firm may reach out to the customer directly through its sales force or retail sales outlets (e.g. electronic calculators and Bata shoes). Another firm may only be content with producing the goods and leaving it on its premises to be lifted and ultimately made available to the customer through a chain of independent wholesalers, dealers, retailers and so on. In the second case, if the distribution channel has guaranteed a certain volume of off-take over a period, then the firm is only to plan its internal production system to mesh with the off-take volume. The ups and downs in interim demand are absorbed in the distribution channel. For the first kind of firm, however, the waves of demand shifts by customers impinge directly on the firm. The task of anticipating these waves, and gearing its

*Annual Survey of Industries data may be used to compute this ratio, although these data are always rather out of date.

internal operations to meet them half-way at least, can no longer be left to the various stages of an external distribution system. The responsibility for planning to combat demand changes lies within the firm where marketing is done directly by itself. A picture of this comparison may be obtained by looking at those firms which sell tea solely through the auction and those which sell in packets to consumers in urban as well as remote rural areas. In the former situation there is no marketing planning at all. In the latter, a lot of effort goes into selling. The second situation in tea is again different from that in shoe selling by Bata. While Brooke Bond does not have its own retail selling outlets, Bata has. For Bata, the knowledge of shifts in demand is directly available, while for Brooke Bond, it is indirectly transmitted through various layers in the distribution system. Thus, planning for coping with demand changes should be more complex for firms which approach customers in the manner of Brooke Bond, rather than in the style of Bata. For the firm selling tea in the auction, the problem of managing changes in demand by ultimate customers does not arise. We thus have three situations : (a) no link whatever with the ultimate customer ; (b) direct link with the ultimate customer ; (c) indirect link with the ultimate customer through a distribution chain. In this chain there could be three links i.e., (i) wholesaler, (ii) dealer, and (iii) retailer.

Thus, we would have altogether five types of association with the ultimate customer. A firm having no link with the customer should have the least need for planning from the demand management viewpoint; a firm having direct link will have more need for planning than the first; and firms which use one, two or three links in the distribution chain should have progressively more and more need for planning. The suggested operational scale is therefore, as follows :

No link	Direct Link	Indirect Link through Retailer	Indirect Link through Dealer and Retailer	Indirect Link through Wholesaler; Dealer and Retailer.

VIII. Extent of Diversity : For our purposes here, only three chief parameters of diversity will be considered : (a) number of distinct products; (b) number of distinct markets; and (c) number of separate plant locations. A few examples will clarify the meaning of these parameters.

Thus, a paints manufacturing firm has : (a) two distinct products,

namely, anti-corrosion paints, and decorative paints; (b) three distinct markets, namely, industries, householders, and exports; and (c) two geographically separate plant locations.

Again, a tea company has : (a) two distinct products, namely, 'Dooars' and 'Darjeeling' tea; (b) two distinct markets namely, 'Calcutta auction' and 'London auction'; and (c) twenty distinct tea plantations and manufacturing plants.

Lastly, a battery manufacturing firm has : (a) two distinct products, namely, 'automotive' and 'industrial' batteries; (b) two distinct markets namely, 'original equipment' and 'replacement'; and (c) two geographically separate plants.

We would suggest that the degree of diversity is a joint function of the three aforementioned variables. If the numerical values of all the variables are multiplied we would get a composite figure reflecting roughly the magnitude of diversity. Thus, the degrees of diversity of the three companies above are 12 (2x3x2), 80 (2x2x20), and 8 (2x2x2) respectively. Based on this logic the following scale is suggested :

Points 1 to 9	10 to 20	21 to 40	41 to 60	61 and above

Higher the total points score, greater the diversity, and hence, stronger the need for corporate planning.

IX. Size of Business : One could here think about either the size of existing business, or the contemplated size of business in the years to come. In either case, larger the existing size or bigger the planned size, greater is the need for formal corporate planning. But the basic operative question is : which size measure is appropriate? Several alternatives are available, e.g., (a) Paid-up share capital (used by the Reserve Bank of India); (b) Sales value (used by the Economic and Scientific Research Foundation, Delhi); (c) Total Assets (used by the *Economic Times*).

Each parameter has its own problems. Depending on the debt/equity ratio adopted by a firm, using the paid-up share capital amount alone could indicate either a bigger or a smaller size, which may not at all

reflect the actual scale of operations. Total assets suffer from the flaw that in cases of high underutilisation of capacity, the true magnitude of operations may not be revealed. Besides, there is the problem of widely disparate dates of establishment of the enterprise, causing the comparative money value of fixed assets to be distorted (e.g. HSL vs. IISCO or TISCO). Yet, from the viewpoint of underutilisation of capacity with large total assets the need for rigorous corporate planning may be all the more emphatic. Coming to sales value, although it is at current prices and is free from variations due to differing debt/equity ratios amongst firms, yet it is linked up with the degree of assets utilisation. If high levels of total assets are well managed, sales should also be higher. With poor management of total assets, sales are likely to be lower.

Thus, the relative intensity of corporate planning need should be greater for a firm with a lower ratio of sales to total assets, than for a firm with a higher ratio. The point is : high or low sales value figures on their own may not fully reflect the need for corporate planning. Nor might gross total assets alone do this. But, while the use of sales to gross total assets ratio or its reciprocal is being suggested, this leads us to the problem of widely differing dates of acquisition of fixed assets. The sales figure in the numerator (or denominator) will be at current prices for all firms. But not so for fixed assets. Technically, each firm may like to consider converting its fixed assets to current price level by the general price level index. There will be problems which may affect the value of the sales figure too, either on its own or in the context of the above ratio, e.g., regulated, subsidised or pegged prices for various public sector units, or for units in particular private sector industries. Despite all these problems, however, inter-firm and inter-industry studies are done with such parameters of size in all parts of the world.

So far as planned growth in size, and the need for corporate planning, therefore, is concerned, the issue of sales versus assets reappears again in the form of trying to reach an estimated level, instead of consolidating and managing a level already reached. Thus, one firm in a consumer goods industry began with an estimated profit before tax of Rs. 2.58 crores (implying a certain sales value) on a total capital employed net) fixed assets+working capital) of Rs. 6.75 crores in 1975, and chalked up a projection of total PBT of Rs. 154 crores by 2000 A.D. What semed not to be clearly appreciated, among other things, at that stage

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management by 'what' and 'how' it does, rather than by what academic or professional labels are attached to various job-holders. One meaningful way of looking at the 'how' of the overall management process in a firm is to examine its organisation structure in terms of the concept of 'differentiation'[2]. Given the same size (by sales) for several firms, greater the differentiation, greater the prima-facie reason for considering it to be more professionalised. Thus, we have found in one organisation that there is an 'Overheads Accountant', amongst others. In another there were management accountants specifically differentiated by 'marketing' and 'Production' labels for one product division. In the production function in one organisation there was a separate 'Raw Materials Recycling Manager'. On the other hand, in one firm we have seen corporate planning, taxation, management training—all devolving on the Finance Manager. There does not exist even an Industrial Relations

1. Chakraborty, S. K. 'MBO and Professional Management', *Management Annual, 1973, Various aspects of professional management have been dealt with in depth in this article.*

of forecasting was the asset or capital employed backing necessary to support a PBT of Rs. 154 crores. The data of past 10 years for similar consumer goods industries showed that to earn Re. 1.00 of PBIT, average total assets needed ranged from Rs. 5.5 to Rs. 8.5. This meant that, roughly speaking, total assets of a magnitude between Rs. 885 crores to Rs. 1,306 crores might be necessary to attain PBT of Rs. 154 crores (loan capital was almost nil in the projections of sources of finance so that PBT and PBIT would be equal. Obviously, such a scale of growth plan does emphatically point to the need for comprehen-

Manager in this firm which is highly labour intensive and has nearly twenty different operating units. We would suggest that the last kind of firm is relatively less professionalised than the first three. For, differentiation indicates the degree of refinement in recognising which activities need concentrated and specialised attention. This method of assessment is more operational, less subjective, and free from need to define who is a professional and who is not, and who is an employee and who is an owner. The only major weakness this method may suffer from is that smaller firms, with less ability and need for such differentiation, may be adjudged as less professionalised. However, comparisons within similar size groups (say by sales) should be meaningful. Thus, within each size group, the total count of such differentiated managerial role titles in all functional areas together should indicate the relative degree of professionalisation. And, greater is such professionalisation, the more is the need for formal corporate planning to bring about necessary integration throughout the organisation. The suggested scale is accordingly :

Upto 20	21 to 30	31 to 40	41 to 50	51 and more

Mapping the Corporate Planning Need

Having suggested an inventory of structural-environmental factors which could, in various combinations, prompt comprehensive and formalised corporate planning, we may now see how a single firm might use that framework to assess the degree of planning need for itself. Each factor has been expressed in terms of a five-point scale, ranging from 1 to 5. And since objective measures have been suggested for each factor-scale, the firm in question could easily find the relevant value between 1 and 5 for each factor as obtaining at a point in time within itself. The following chart shows a hypothetical corporate planning need score for a given firm.

2. Chakraborty, S. K. & De, S. L. — Differentiation and Integration in the Accounts and Finance Function in Indian Firms – forthcoming in *Indian Management. The salient features of differentiation have been explored in this paper.*

Corporate Planning Need Chart

Factors	Scale					Score
	1	2	3	4	5	
1. Derived Demand	*					2
2. Depth of Processing			*			3
3. Competition		*				2
4. Foreign Ownership	*					1
5. Institutional Finance				*		4
6. Capital Intensity	*					1
7. Link with Customer				*		4
8. Diversity					*	5
9. Size			*			3
10. Professional Management		*				2
TOTAL						27

Thus, in a 10-factor, 5-point scale matrix, the maximum score is 50. Against this, our hypothetical firm has scored 27. The significant point is that this score of 27 is based on objective, data-based assessments of the state of each factor considered in the above map. The next question that arises is : what is the utility of deriving this score ? A general answer to this can be : if firms in the same industry adopt such a common matrix (or any other matrix with different factors-scale mix), then higher the score obtained by a firm, greater should be its need to engage in corporate planning. We do not, of course, imply that a firm with the smallest score in the group should not go in for corporate planning. Much would also ultimately depend on managerial attitude. The urge for planning as a way of life might transcend the apparently low score on objective factors. However, it is likely that in such cases it is just one or two persons in the whole organisation who would strive to keep the momentum alive. The absence of pressures from objective factors may lead to a lack of more universal compulsion throughout the organisation to provide adequate support to the torchbearers.

Another aspect of importance may also be noted. In the above example the score of 27 represents the total assessment as of *now*. It should, therefore, provide a useful starting point for a firm to look ahead for the next 5 or 10 years in terms of likely changes in various factors and their probable impact on it. For instance, referring back to the above map, let us suppose the firm is contemplating in the next 5 years to replace its old equipment with high-priced, and more capital intensive machinery for which substantial additional institutional financing is likely to be necessary. With more capital intensity, planning need for labour on the one hand, and for capacity utilisation on the other should increase. Greater dependence on financial institutions will exert additional pressure for better planning than before. As a result, the score for capital intensity might go up to 3 (from 1), and for institutional dependence to 5 (from 4). Thus, the total need score would be 30. In addition, if it is anticipated that the government may encourage more competition in this product line during the next 5 years, then the score against this item could increase to, say, 3. Total score would now be 32. In other words, a firm is helped by this matrix to reassess and revise the degree of its corporate planning need, and the consequent stress on its satisfaction, on a continuous basis.

It should be added that the process of identifying a list of factors as suggested above, and the effort in finding the value for each factor on the 5-point scale, is in itself a systematic method of self-introspection. Many hidden faces of the enterprise, or their dimly perceived outlines, might now stand on the stage for distinct observation. Moreover, these would now appear together, all at a time, for an appraisal of the cast in totality.

Conclusion

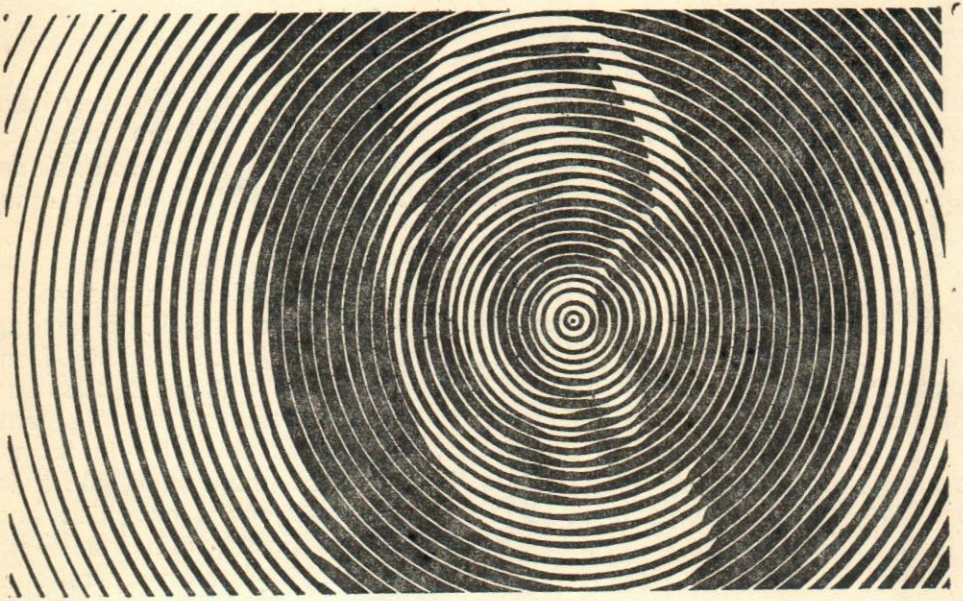
(1) It is not claimed that the ten factors discussed above constitute a full inventory. The scale-measures suggested may also be short of perfection. Yet, they are probably a very near representative of the forces impinging on Indian business today. The list could be suitably adapted to accommodate other industry-specific factors, e.g., raw material supplies, source of labour, foreign collaboration, etc.

(2) The framework discussed above should be equally applicable to

public sector enterprises. Only the institutional finance factor may have somewhat less relevance than in the private sector, and the factor of foreign-ownership would be non-existent. The way professional management has been defined here, it would apply to all firms—whether in public or in private sector.

(3) As for the private sector, it appears that the problem on the whole would tend to be more and more one of conflict-resolution among multiple corporate goals. Multiplicity of corporate goals results from increasing concern of society and its government with what business does and should be doing. The thrust for professional management, in the sense of incorporating broader social values and goals in formal corporate management, should thus be reflected more and more in corporate planning efforts. In so far as these new social priorities and values find expression in some of the factors listed, this framework should help a firm to see some light while groping for an operational answer to the question of linking corporate management to society's needs.

(4) Lastly, it may be useful for various industries, through their respective associations, to engage in an exercise to determine the industry-specific values corresponding to each segment of the 5-point scale for each factor. In the same way as in inter-firm comparisons, the results of this exercise should enable firms belonging to each industry to measure their respective corporate planning need in relation to the overall industry pattern. Without uniformity in the boundary values of each segment in the 5-point scale, each firm may derive a wholly incomparable score in relation to those of others in the same industry.



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Corporate Planning Process : A New Approach

Rakesh Kumar*

'Corporate Planning is done at corporate level for corporations only', is one of the most common myths about corporate planning. Many organisations in India, therefore, do not find it necessary to carry out any systematic planning at the company level in the strictest sense of the term. While misconceptions have been responsible, to certain extent, for the slow rate of diffusion of corporate planning in industry, there are other reasons too. According to Russel L. Ackoff, 'the need for corporate planning is so obvious that it is hard for anyone to be against it. But it is even harder to make any planning useful. Planning is one of the most complex and difficult intellectual activities in which man can engage. Not to do well is not a sin but to settle for doing it less than well is. [1]

Therefore, another significant point to the disadvantage of corporate planning has been 'not done well'. The objective of this paper is to present a method of preparing corporate plan and doing it well.

Corporate Planning

'Corporate Planning' has been defined in a number of ways. Some of them are mentioned below :

'Corporate planning is the provision and allocation of resources according to long-term objective. This involves total planning (the word 'corporate' meaning 'total' in this sense), but may not be very long term. [2]

'Corporate, long range planning is not a technique. It is a complete way of running a business. Here, the future implications of every

*The author wishes to acknowledge Mr. Olaf Kleine, RKW Expert, Federal Republic of Germany, under whose guidance, the various concepts discussed in the paper were developed.

decision are evaluated in advance of implementation. Standards of performance are set up beyond the time horizon of the annual budget. [3] The word 'corporate' planning is often used to signify the planning of the 'total' business in the long term'. [4]

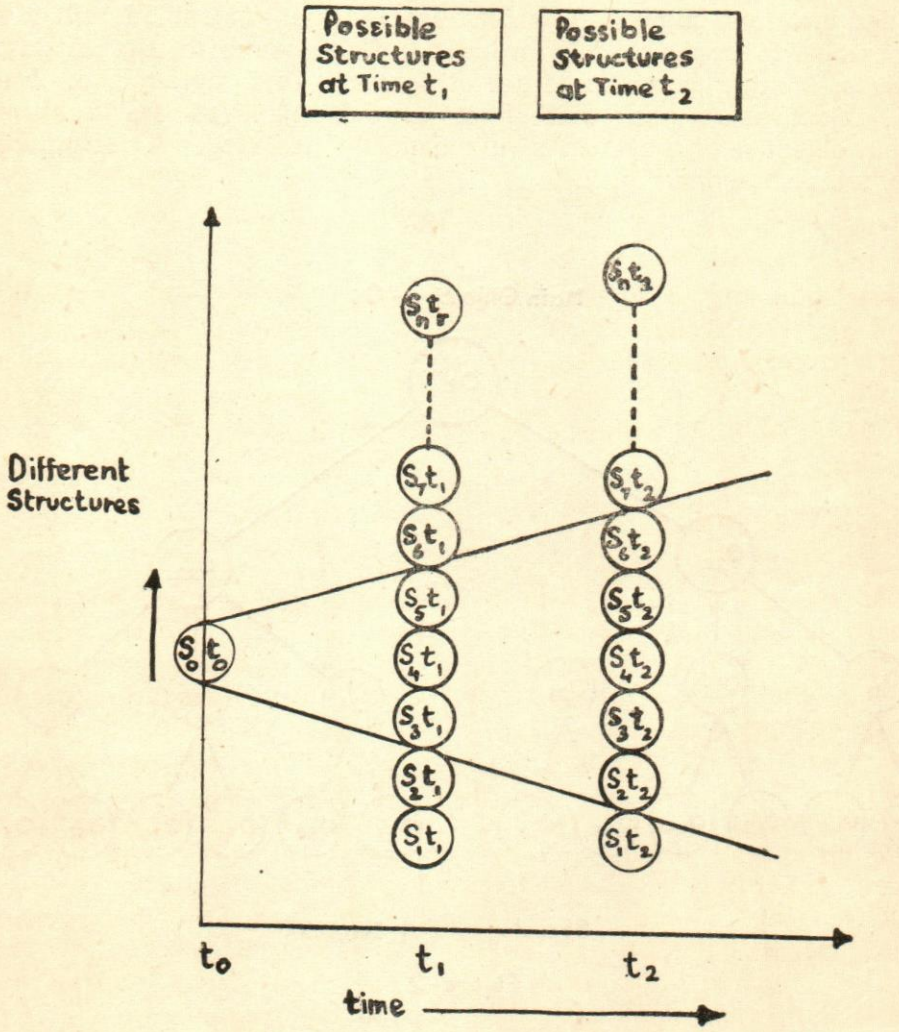
All these definitions mention one or the other facet of corporate planning, but none of them explain corporate planning in its totality. An attempt is made here to bridge the gap between the above-mentioned definitions of corporate planning and what it actually is.

Corporate planning is a *heuristic* procedure of : *Searching, Finding, Defining, and Writing down Structured sub-targets,* their *alternative actions* and their *relevant resources*—in order to achieve the main *Objective* of a system. For better comprehension of the above process some of the terms used in the definition need further clarification.

Objectives

Objective(s) is a wanted and described structure of a system at a defined time range in future. This can be better understood with the help of an illustration (Fig. 1), where system x represents s business, company, industry or any organisation where corporate planning is to be introduced. At time t_0 the structure of the system is represented by st_0 Depending upon our capacity to foresee future, we can estimate the structures, the system x can possibly have in the short term; say t_1 and in the long term say t_2. From the figures it is clear that at time t_1 and time t_2, there are a number of possible structures of the system x, and of all the possible structures only some are desirable and others are not. The desirable structures are shown in the beam and others are outside the beam. Objective is a description of the parameters of one of the desirable structures to be achieved at any time in future. The three main characteristics of an objective are : (i) as abstract as possible; (ii) quantifiable; and (iii) attainable. The main objectives are invariably so abstract that it is not possible to relate them to various actions required to achieve them. Therefore, the endeavour is to find out those sub-objectives which are action relevant.

This is possible only if the main objective is broken down to result in a target structure.

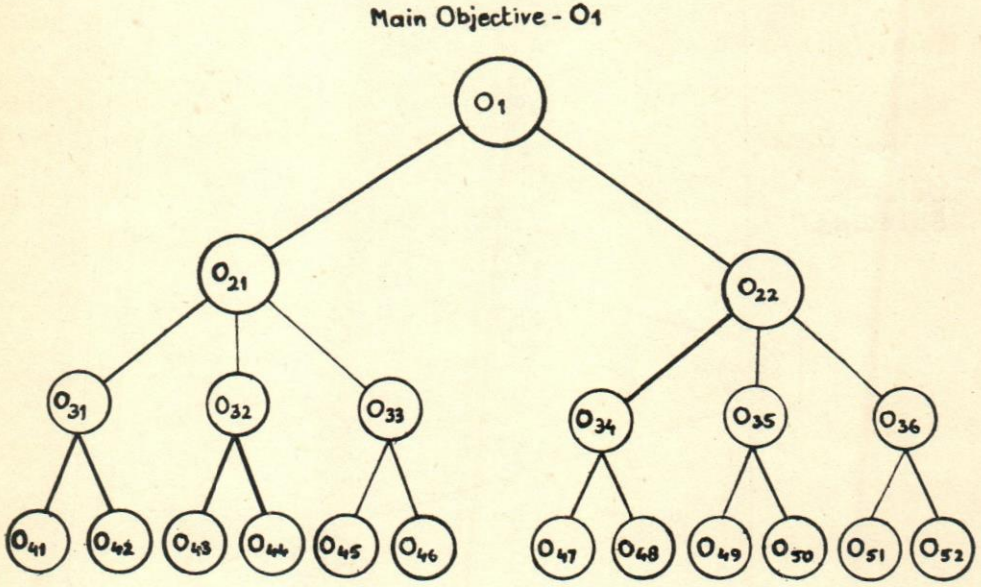


Different Structures of System- X in time range

Figure- 1

Structured Sub-Targets

In order to evolve a target structure, the main objective of a system is classified into sub-objectives which are further classified till it is not possible to continue this process. This results in a pyramid of objectives, in other words, a target structure. This pyramid of Inter-elated objectives is such that if these sub-objectives are achieved the main objective of a system is automatically achieved. A structured sub-target is shown in Fig. 2.



Structured Sub-targets

Figure-2

O_1 is the main objective of the system. It is achieved if sub-objectives O_{21} and O_{22} are attained. Similarly O_{21} is further dependent on O_{31} and O_{32} and O_{31} is further dependat on O_{41} and O_{42}. In order to complete

the target structure this process of classifying into sub-objectives is continued till action relevant sub-objectives are reached, i e., the ones for whom the actions to be performed to achieve them can be spelled out. More abstract an objective is, more difficult it is to relate it to the action required to achieve it. Therefore, it becomes necessary to break down the objective till we get action relevant objectives. While preparing structured sub-targets the arithmetical relationships between sub-objectives should also be put down. Evolving a structured sub-target is a creative job and needs to be undertaken by a group of creative managers. Once the structure is ready, it should be filled with data. Arriving at acceptable and practical data is a laborious heuristic procedure.

Heuristic Procedure

It is a procedure of trial and error. One can start filling the structure from top (planning downwards) or otherwise (planning upwards). But

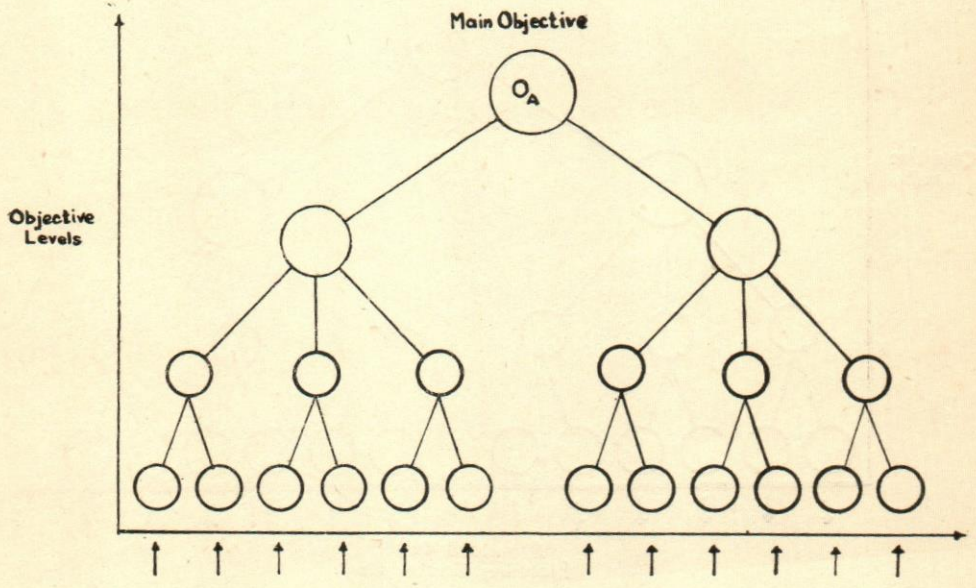


Figure- 3

both these have to be carried out a number of times till acceptable and practical data for the structure is achieved.

Planning Upwards : If we substitute in the target structure actual data at the bottom we can compute O_A, the main objective (attainable). This is shown in Fig. 3. If O_A is not same as O_s the desired main objective (standard), substitute O_s in the structure and plan downwards.

Planning Downwards : With the value of O_s, the standard objective to be achieved at the top and going down the structure we get the values for action relevant sub-objectives. This becomes standard data as shown in Fig. 4. If these standard values cannot be achieved due to lack of resources or other reasons, we plan upwards with new values to find out the value of O_s that can be achieved. This process is repeated till we have a structure filled with acceptable and practical data.

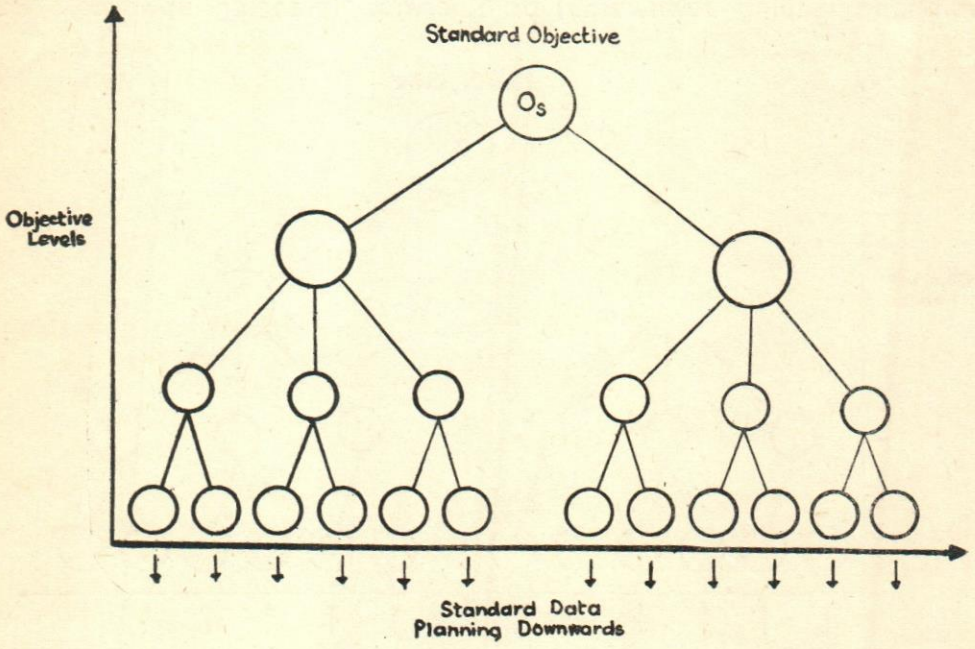


Figure - 4

Alternative Actions

When we substitute the accepted and desired standard value of the main objective in the target structure and go down to the lowest level of sub-objectives, we get standard values for action relevant sub-objectives. These standard values, may be different from actual ones. In other works, gap exists between the actuals and standards. In order to bridge the gap a number of alternative actions can be laid down for each of the values. Out of these alternative actions, the management has to select one for implementation. This can be done with the help of various quantitative techniques available for evaluating alternatives. This is shown in Fig. 5.

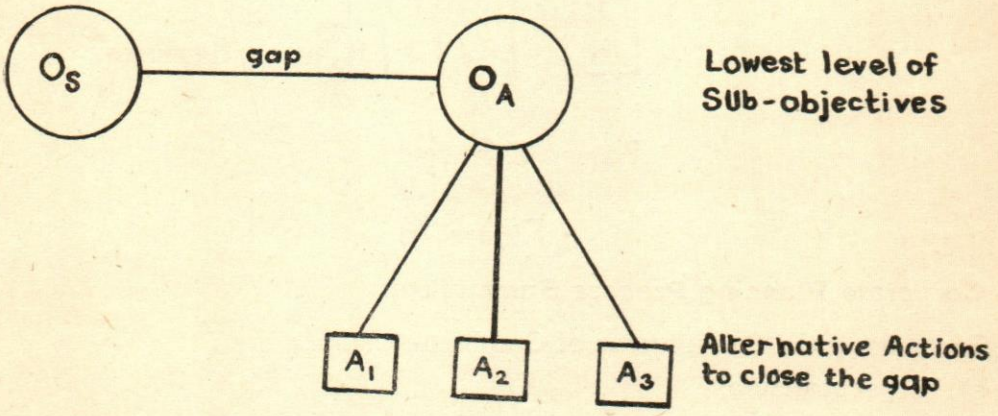


Figure - 5

Relevant Resources

To make a choice between the various alternative actions, one criterion can be the action needing the least of resource. For this, relevant resources should be spelled out and evaluated against each other.

Secondly, for implementing various actions, the resources have to be planned. This is shown in Fig. 6.

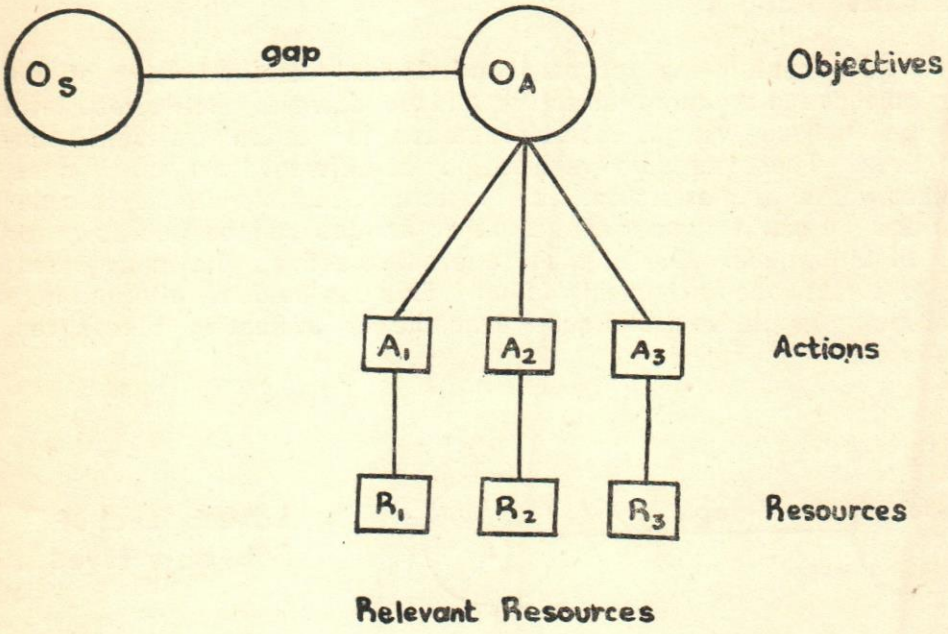


Figure-6

Corporate Planning Process Summarised

Three essential Constituents of Corporate Planning are :

a) Target structure;
b) Action plans; and
c) Resource plans.

The step-wise approach for evolving the above-mentioned constituents is summarised below :

Step 1 : Classify the main objective into sub-objectives till action-relevant sub-objectives have been evolved.

Step 2 : Arrange the sub-objectives in the form of target structure, giving all the inter-relations between the sub-objectives

Step 3 : Substitute the desired value of the main objective, i.e., standard value in the structure and plan downwards.

Step 4 : Formulate the actions and the resource requirements.

Step 5 : In case of gap between desired and available resources, substitute the resources available and plan upwards to find out the value of main objective.

Step 6 : Repeat this process till acceptable and practical values for objectives and resources are achieved.

Step 7 : Implement the plan to achieve the main objective.

Step 8 : Follow the progress and accordingly, update the plan.

REFERENCES

1. Russell L. Ackoff — A Concept of Corporate Planning, N. Y., John Wiley & Sons, 1970, pp.1

2. Peter Baynes, — Case Studies in Corporate Planning, London. Sir, Issac Pitman & Sons Ltd., 1973, pp. 4

3. Hussey D. E. — Introducing Corporate Planning Programmer Press, pp. 5

4. H. F. Rober Perrln — 'Focus the Future', London, British Institute of Management, 1972, pp. 5.

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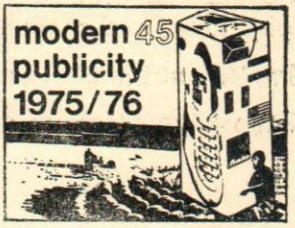

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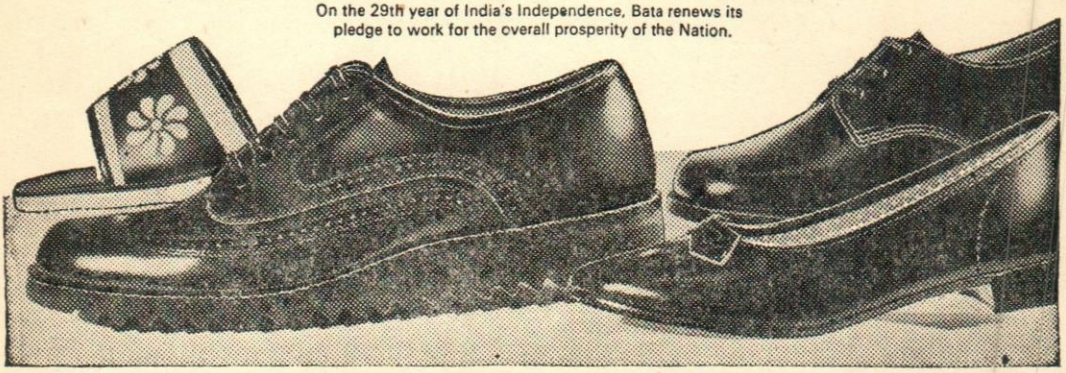

Corporate Planning in a Multi-Product Organisation

P. C. Basu

The subject of corporate planning has come into lime light only during the last few years. It is often described as an important tool of management. In fact, it is not merely a tool but forms the very core of management function.

A distinction can be made between two main aspects of management; one is the managerial aspect which is concerned with day-to-day running of the business and the other is the entrepreneurial aspect which is concerned with questions such as what should be the nature of business, what should be the size of the business, what should be its rate of growth, what should be its profitability and so on, in say, five to ten years from now. This entrepreneurial aspect of management is of vital importance for the long-term interest of the company and should receive the maximum attention.

Evolution of Long Range Planning

The need for planning and control of the operational aspects of a business was recognised and a suitable management technique for this purpose was evolved some time ago. Twenty-five years ago, progressive companies gradually started introducing systems of budgetary control in their organisations. Later, various refinements have been introduced to make the system more effective. Recognition of the need for planning and control of the entrepreneurial aspects of a business, however, came much later and it is only during the last eight to ten years that it has started to attract corporate attention and that too in a few progressive organisations. The techniques are still being evolved through a process of trial and error, and it will perhaps take some time before a set of well-tried-out techniques are established in this field.

Although long range planning as a technique has been developed late, it is expected to gather momentum in future, mainly on account of three reasons. In the first place, corporate organisations operating at a

fraction of their true potential could, in the past, carry on in that state indefinitely without any serious threat to their independent existence. The large number of 'take-over' bids in the western countries since early sixties, however, gave a rude shock to the top management of many a large organisation and have made them feel that unless the potentiality of the business was fully utilized, the threat of 'take-over' would hang over them. Long range planning was considered by many of them as the only means of achieving fuller utilisation of potentiality, so necessary for evading likely 'take-over'. The second reason is the rapidity with which changes are taking place in recent years in the environment in which companies operate. Long range planning, it is felt, puts the companies in a better position to take advantage of opportunities or face up to the threats posed by such rapid changes. The third reason is the tendency of large organisations to diversify their activities. In a multi-product organisation, a whole set of new problems come up at the entrepreneurial level which are not encountered in a single-product organisation and these problems can be satisfactorily dealt with only through Long Range Planning.

Concept

Corporate Planning has been defined as a systematic attempt to influence the medium and long-term future of an enterprise by defining company objectives by appraising those factors within the company and in the environment which affect the achievement of these objectives; and by establishing comprehensive but flexible plans which help ensure that the objectives are in fact achieved. Corporate Planning, as defined here, involves the following :

(a) A clear definition of the company objectives both quantitative and qualitative to be attained during the plan period. The objectives should be challenging and yet realistic enough to be capable of achievement.

(b) A careful searching study of the environment, present and prospective, so as to identify the potential threats to the business on the one hand and potential opportunities on the other.

(c) An appraisal of the strengths and weaknesses within the company so as to be able to arrive at a balanced view of the company's ability

to take advantage of the potential opportunities or withstand the potential threats. The objectives originally proposed should (at this stage) be reviewed in the light of the study of the environment and corporate strengths and weaknesses, and if necessary, modified.

(d) Development of suitable strategy or course of action for reaching the objectives. Quite often, there will be more than one possible strategy for achieving given end-results. At this stage of planning process, alternative strategies should be evolved and compared in terms of their financial and other implications and careful consideration given to the level of risk associated with alternative courses of action.

(e) Finally, once an appropriate strategy has been selected, this must be translated into specific short-term goals or targets for the company as a whole and for divisions or sub-units.

Techniques of Corporate Planning in a Multi-Product Organisation

In a multi-product organisation, long range planning is carried out at two levels; corporate level and the individual business level. The process of defining objectives and developing strategies in such organisations follows the course of 'top-downwards' and not 'bottom-upwards'. The quantified objectives of the entire organisation are not arrived at by cosolidating the quantified objectives of the various individual businesses, but it is the other way. Quantified objectives are first set for the company as a whole and thereafter objectives or roles are assigned to individual businesses in a manner suiting the corporate interest.

Strategy Planning for Individual Business

The steps involved in the formulation of strategy for individual businesses can be summarised as :

(i) Segmentation of the total business of the company into separate business areas for formulation of strategy. Normally, a segment would embrace a product or product group which requires separate market or investment strategy.

(ii) Analysis of the basic characteristics of the business in terms of its market and cost structure.

(iii) Analysis of company's strengths and weaknesses in relation to the particular business.

(iv) The key requirements for success as identified through the foregoing analysis.

(v) Analysis of the past and current situation in terms of sales, gross margin, profit before tax and interest, operating cash flow, capital employed and return on capital employed.

(vi) Analysis of the competitive situation with full particulars of the main competitors' turnover, capacity utilisation, market share, profit and profitability.

(vii) Statement of the quantitative and qualitative objectives for the individual business. For this purpose, consideration should first be given to the role which the particular business has to play in the overall corporate plan.

(viii) Consideration of the various options available to the company for achieving the objectives.

(ix) Selection of the preferred strategy.

The preferred strategy is then reduced to a financial statement showing sales, growth percentage in sales, profit percentage, return on capital and cash flow. A few other important financial ratios are also worked out. Action programmes are then prepared to ensure that necessary efforts would be made to achieve the objectives for the business during the plan period.

Planning at Corporate Level

In a multi-product company, the nature of planning at corporate level depends largely on whether the company is organised on functional basis or on product division basis. Where the company is organised on a functional basis, the scope for planning at two levels, product and corporate, are limited and perhaps this itself represents a weakness of this form of organisation. However, in case of a company organised on

product division basis, the planning at corporate level takes on very much the character of purely financial planning because the other functions namely marketing, production, procurement, plant capacity, manpower, etc, will have been taken into account at individual business level.

The planning process starts with a definition of the company objectives for the plan period in quantitative terms, e.g., growth in turnover, profit, return on capital and, what is perhaps most important, earnings per share. The objectives should be challenging and at the same time realistic, taking into account past performance and future opportunities and threats. It may be mentioned and although these objectives are interlinked, to a certain extent, it is desirable to set separate objectives for them because separate strategies might be necessary for each objective. Thus, return on capital depends not only on profit but also on utilisation of fixed and current assets; again, earning per share would depend not only on return on capital but also on financing policies such as level of capital gearing etc. As already explained, the various quantified objectives at corporate level, would in turn, have to be reflected in corresponding objectives of the various product groups.

Developing Strategies at Corporate level

Strategy at corporate level has to take care of three aspects: (i) soundness of the investments; (ii) soundness of the financing policy; and (iii) adequacy of cash flow.

Investments : In a multi-product organisation, the basic problem of corporate planning centres round questions such as, how much should be invested, in which business, at what point of time and on what basis. The corporate objectives in the matter of allocation of its resources would be to aim at building up a balanced business portfolio on a long-term basis. The advantages of a balanced business portfolio are first, to strike a correct balance between profit performance and risk bearing; secondly, to safeguard as far as possible against cyclical fluctuations in business and, finally, to ensure adequate cash flow to match the requirements of planned corporate growth. For the purpose of developing a balanced business portfolio, use can be made of a new technique of financial business analysis which is explained below.

The various businesses of a multi-product organisation can be grouped under four distinctive categories in relation to the growth potential of their total market and their share of the total market vis-a-vis the other competitors :

A High Share—Low Growth
B High Share—High Growth
C Low Share—High Growth
D Low Share—Low Growth

The theory behind this categorisation can be summarised as follows :

(a) Businesses with a dominant position in slow growing markets tend to generate surplus cash because a position of dominance should enable them to earn good profits, whereas such businesses will not be required to plough back too much of their profits in expanding plant capacity and increasing working capital because they would be growing at the same slow rate as the total market and yet holding their share.

(b) There would be other businesses which would tend to absorb cash. Businesses in fast growing markets need high investment levels to expand capacity and increase their share of the market. The cash needs of such growth business will be even greater if another company is dominant, and therefore, forcing down the profitability of the smaller company through price cutting or costly promotions.

A business in a market where the growth potentials are low and the present market share of the organisation is also low, is not likely to be viable even in the long run and, therefore, the strategy should be to try to spin off on as advantageous terms as possible. Apart from ensuring a balanced investment portfolio, a company has also to ensure that the overall profitability of the company is maintained at a satisfactory level. For this purpose, it is necessary to ensure that all capital investment proposals are subjected to critical financial evaluation before acceptance by management. Now-a-days, this is usually done through Discounted Cash Flow (DCF) technique. The evaluation under this system becomes more comprehensive as compared to the other techniques, e.g., return on capital or pay back method as it takes into account (a) the full life span of the project, (b) the present value of future earnings and (c) the income tax relief aspect.

(ii) Financing Policy : For an organisation, establishment of a sound capital structure is as important as the development of the balanced business portfolio. Careful consideration is required to be given to the extent to which financing should be done through internally generated funds, or through issue of fresh equity, or through loan or overdraft. The optimal mix will depend on the nature of the business, the risk element, the proportion of investment in fixed assets and working capital as well as the company's policy with regard to capital gearing. The technique of using high gearing for increasing the earning per share out of the same profit is fairly common. Care should, however, be taken to ensure that it does not exceed the safety limits. The practices in this regard vary from country to country. Under Indian conditions the Reserve Bank restrictions serve as the primary limiting factors.

(iii) Cash Flow : A careful assessment of the future cash flow is an important aspect of corporate planning and adequacy of cash flow may be regarded as a major objective of strategy planning. As already indicated, this consideration is of great significance in the selection of investment portfolio.

The effect of inflation on cash flow should receive special consideration at a time of rapid increase in price level. In such a situation, massive additional investments are required, even for maintaining production at the same level, because fixed assets are required to be replaced at substantially enhanced costs and working capital also may tie up larger funds. If a company embarks on expansion programme without taking into account this aspect, its resources may get stretched beyond safety limits, causing serious financial crisis or it may have to abandon midway the expansion programme at a substantial loss.

Inflation

One of the major problems encountered in long range planning is the difficulty of making suitable provision for inflation. Any major change in the rate of inflation compared to the basis on which plans have been made completely upset the picture. The only course open to management in this regard is to prepare contingency plans taking into account varying degrees of inflation. Periodical review of the position would, of course, be necessary.

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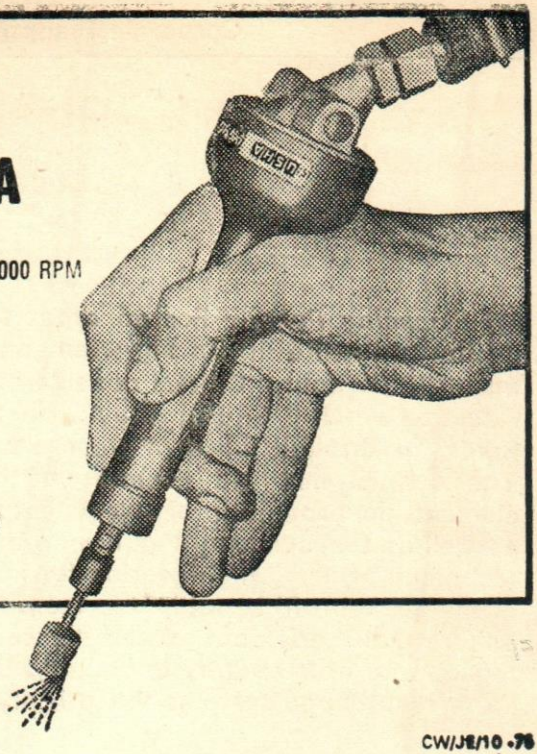

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Management by Objectives

Narendra K. Sethi

Management literature abounds in glittering tributes and scholarly approval of the 'Management by Objectives' doctrine. Textbooks, articles, and profound corporate manuals—authorized by practising managers and academicians—continue the tradition of accepting and propagating this administrative philosophy. The practice is by no means limited to the American scene. Literature produced in other countries also supports this theory. In a nutshell, this doctrine refers to the process of establishing certain 'objectives' or corporate goals towards which everyone labours actively both within and outside the corporate environment.

The organizational climate around the world has changed so rapidly and so drastically that this doctrine can no longer serve any meaningful purpose. It is doubtful whether this doctrine had served any purpose in the past other than presenting to the coroprate executives and workers, a pretext of unqualified co-ordination and integration. This doctrine was used, tossed, and kicked around *ad infinitum* without any realization of how it worked, what it did, or what it stood for. It is high time to present a total and complete expose of this doctrine with a view to understanding its obvious fallacies, and half-truths—thereby preventing any wasted effort on the part of modern executives in unnecessarily trying to foster it in their organizations.

Assumptions

The key assumptions made in this doctrine are :

(a) Organizations need objectives;

(b) Objectives should be dynamic;

(c) Every member of the organization should work towards these predetermined objectives;

(d) Survival and growth are essential objectives;

(e) Objectives should be in a written form and should be communicated to everyone;

(f) Departmental sub-objectives should be sacrificed for the *broader* objectives of the organization;

(g) Top management should devote a major portion of their time towards these objectives.

In the light of modern organizational behaviour, empirical research data, and overall effective administration, these assumptions appear to be superficial and on an action-level, quite detrimental. The subsequent paragraphs present an analysis of these assumptions.

Do Organizations Need Objectives?

The question which arises is—whose objectives? Are objectives the predetermined legacy of 'top' management, 'middle' management, workers, public or a combination thereof ? The modern organization is no longer an entity which can be solely governed from within; that is, by the administrators in a vacuum of external considerations and forces. Furthermore, the corporate executives of today cannot arbitrarily select a slate of unique objectives for their own organization. The classical list of objectives reads like a page from an 'etiquette book'—all sweetened with high-sounding, but ineffective cliches, virtues, and overt acts of highly fashionable morality. As a matter of fact, a close study of available corporate objectives would indicate a very significant degree of uniformity and commonness which cannot be brushed off as being only incidental. If every large, medium, or small-sized corporation subscribes to the same-sounding and same-meaning corporate objectives, there is indeed no reason to have objectives at all.

Objectives in most organizations are visionary and futuristic—stressing research, dedication, service and doctrines of social responsibility. Once determined, they are kept on file to appease dissident workers or to woo desirable managers. It is extremely doubtful that organizations survive due to objectives. However, it seems more plausible that objectives are in fashion because of organizations.

Are Dynamic Objectives Required ?

If one were to accept the doctrine of 'Management by Objectives', the predetermined requirement of those objectives being *dynamic* is open to doubt. One would question this built-in preference for dynamism—whatever connotations and shades of meaning one chooses to give to this word. The fact is that corporations thrive on proven products, solid customer mix, traditional communications and an equally traditional horde of corporate executives, even in terms of their race, religion, education background, upbringing, address, and personal characteristics. Behind the facade of neo-modernism, a successful corporate organization continuously but passively, deliberately but indirectly tries very hard to sustain, cherish, and develop proven characteristics and features of success. The profile of a highly successful and effective business executive in general, stresses traditional values and de-emphasizes modernistic and drastically new ideas.

In this corporate environment, the need for dynamism is often a pretext rather than a prelude to action. It is more a conscious urge to hide rather than a desire to strive. In this way, the so-called 'dynamism' of corporate objectives only results in charging the business goals with a fervour and zeal which are truly impossible to obtain—let alone sustain for any length of time. Both the executive and the non-executive sectors of the organization in general, desire an environment which they know, which they can perceive, which they can touch, and in the final analysis one which does not shatter their frustrations and hang-ups. A dynamic objective—in as much as it establishes (or at least tries to) a totally unrealistic and idealized ambition—can only succeed in breaking the traditional calm and integration of the firm, thereby bringing greater chaos and anarchy than even before.

Should Every Employee Work Towards the Same Objective?

The followers of 'Management by Objectives' doctrine subscribe to a mistaken notion that for organizational health and growth, it is essential that every member of the organization—at whatever level that member may be—must share common goals. Nothing could be more disastrous or unrealistic. There are obvious differences in expectations, aspirations, achievement levels, and motivational patterns at different vertical

organizational levels. Differences in salary, title, and job are by themselves enough to initiate a desire for differentiation and, at times, for different objectives in the executives. Secondly, members of different departments may not always share everything common on objective scales. Production department executives may differ substantially from marketing department members in their respective interpretation of corporate goals. Departmental hostility and conflict is the rule rather than the exception in modern organizational behaviour. Thirdly, employees of a non-executive nature may never be fully aware of what the top objectives of the firm are, and if they are partially informed on these objectives, they may choose to ignore or reject them altogether in favour of their own personal objectives, goals and needs.

At a pragmatic level, it is wrong to expect that every employee of the organization would subscribe to the same corporate objectives. This is neither desirable for corporate effectiveness nor essential for employee motivation.

Are Survival and Growth Universally Required Objectives ?

The proponents of 'Management by Objectives' like to touch a sensitive corporate chord by suggesting that all corporate objectives must stress the creed of 'survival and growth'. They indicate these preferred objectives, perhaps, with a view to lure organizational leaders into conforming with the tenets of their doctrine.

The question is why there should be a direct and active pursuit of survival in the first place ? It appears to be a defensive and defeatist attitude which in the long run makes executives defenders of their rights and apologists for their existence. Like all established institutions, the survival of corporate entities cannot be in the hands of the pious wishes of the executives themselves. The old and classical areas of competition and balance are fast changing in the world of trade. Instead, governmental, public, and social pressures are fast emerging. In such a situation, the outright cry and pursuit of mere survival is a sheer anachronism.

With reference to the creed of growth, one can argue that merely by placing it on the list of objectives, a company cannot manage to grow.

Furthermore, its non-inclusion on the list of objectives is also not *a priori* denial of the company's desire for growth. In the changing socio-economic milieu, the persistent clamour for growth may very well be construed as a desire to become big—a word which is presently synonymous with monopoly. One can also point out that growth in itself is not a highly desirable attribute of a corporate entity. It could lead to malignant growth—mere accumulation of destructive mass—which might beconfused by higher management as being an indication of genuine growth. In more strict business terms, it could mean increased personnel, increased costs, increased outlays in advertising, increased office space and organizational structures without any discernible compensating increase in either net sales or in increased revenue. In all these overt symptoms of obvious growth there lies a built-in device for gradual, but certain erosion of the business firm.

Should Objectives be in a Communicable Form ?

'Management by Objectives' doctrine seems to support the Parkinson's law. By insisting that the corporate objectives be in a written form and by emphasizing that the list of objectives be communicated to every corporate employee, the supporters of the doctrine are preparing a fundamental groundwork for the solution of the problem of executive underemployment. This communication-phobia would cost the corporation a great amount of money. Whether the list of objectives would be read at all by the people to whom it is sent is doubtful. The average employee is a disinterested (and passive) spectator of the bitter corporate game. He has other personal obligations which would take precedence over the list of coporate objectives. Should he find time to read these objectives, he would remain quite insensitive to their words because they are futuristic, visionary, and unconvincing. They also do not touch any sphere of *his* operations. It will be quite hard to involve him, once he is convinced that the corporate objectives are designed with the sole motive of keeping them beyond his reach, his scene of action, and beyond his dreams of personal ambition. In such a setting, the cost incurred in the process of communicating these corporate objectives to the organizational employees would be a net loss for the company.

Should Departmental Objectives be Sacrificed ?

The 'Management by Objectives' doctrine makes a big issue for broad, total, and top objectives for the entire corporation. In doing this, the doctrine states that the departments either sacrifice their departmental objectives or (if they cannot succeed in accomplishing this), that departmental objectives be considered as secondary in importance.

Empirical research indicates that this should not be the case. Departmental objectives are always close to the employees. They can identify these objectives in their schedules, production, output and supervision. The employees interact with one another mainly on a departmental level. It is the identity of the department which the workers cherish most. On the other hand, the totality of the company is an alien concept for the employees. They find it hard to identify themselves with a modern large sized firm.

In such a situation, a disregard for the departmental objectives, which are closely identifiable with the workers, and a curious pursuit of extra-departmental or overall organizational goals for which the workers are both untuned and desensitized, could only be regarded as a calculated effort to break down organizational structure and create dissatisfaction and conflict.

Should Top Management be Engrossed in Objectives ?

Generally, top management is entrusted with the task of preparing, formulating, activating and updating organizational objectives. The term 'top' management is supposed to refer to the board of directors, president and senior vice-presidents including appropriate staff assistants depending upon the size, nature, and overall function of the company. It is expected by the supporters of the 'Management by Objectives' doctrine that 'top' management committees will be devoting a major portion of their administrative time to this multi-dimensional activity of dealing with the corporate objectives.

We have noted the falsity of assumption underlying this doctrine and have focussed on the managerial insolvency of this viewpoint earlier. By making 'top' management actively responsible for this viewpoint and by

forcing upon them a condition by which they are expected to apply a major part of their time (the most precious asset owned by the corporation) in determining appropriate objectives for the firm and updating them at periodic intervals, the organizational processes of the firm will be subjected to severe tension, wasted effort, and loss of productivity. Why should the top executives be expected to wither away their time in formulating high-sounding but hollow corporate objectives ? Why shouldn't they be utilizing their time instead, in things more important, more direct, more sensitive, and more close to them and to the company ? Why shouldn't they use their energies to resolve difficult situations and create a better organizational atmosphere for both the executives and non-executives alike ?

A Substitute Perspective

Instead of supporting the doctrine of 'Management by Objectives' in which assumptions of a highly dubious and suspicious nature are the rule rather than the exception, in which a deliberate effort to substitute idealism for realistic performance is made by all concerned parties, and in which there appears to be a game of wits played between the executives and non-executives, assuring the latter of defeat and annihilation; it might be more effective to develop an alternative approach—an approach which would tend to offset most of this doctrinaire philosophy by initiating meaningful and effective behaviour at all levels. This approach is termed, for want of a better phrase, 'Management by Action'. As conceived in this context, this theory of 'Management by Action' opposes all assumptions of the 'Management by Objectives' school and stresses a realistic, work-centered, and contemporary administrative philosophy. Some of its key considerations can be listed as follows :

(a) Organizational employees must have an action-oriented point of view.

(b) Action must focus on current situations.

(c) Each member of the organization has a different role or action to perform.

(d) Each department must establish whatever action criteria and work attitudes it considers necessary.

21. Reed, J. M. — Some Thoughts on Business Objectives, *Advanced Management Journal*, October, 1964, pp, 65-69

22. Schleh, E. C. — Management by Objectives : Some Principles for Making it Work, *Management Review*, November, 1959, pp. 26-33,

23. Shapton, W. R. — Functional Measurement for Management by Objective, *N.A.A. Bulletin* December, 1959, pp. 61-72.

24. Simpking, J. J. — Planning for Management by Objectives, *Systems and Procedures Journal*, January, 1966, pp. 32-37

25. Stroeseler J. E. — Objectives or Titles, *Personnel Journal*, March 1964, pp. 151-152

26. Wade, M. — Only way to Manage, *Business Management (London)* July, 1967, pp. 34-39

27. Wikstrom, W. S. — Management by Objectives or Appraisal by Results, *Conference Board Record*, July, 1966, pp. 27-31.

28. Wrapp, H. E. — Manage by Objectives or Wheel and Deal, *Steel*, May 21, 1967, pp. 46-7.

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actual operation, working capital requirements, sales, finance, manpower, production and new investments. All these decisions in long range planning must be based on concrete facts.

The planning process imposes a discipline on the company executive to continually consider as he goes along to measure his performance against pre-determined targets of performance so that he knows how he can take advantage of a favourable situation or how to avoid an unfavourable one by timely remedial action. The normal approach, 'we will cross the bridge when we come to it' is thus an anathema to any concept of planning. The economic scheme is constantly changing and this process of change is likely to accelerate in the future, in view of the social, economic and technological context of our times. In this changing panorama, if a company does not plan for its future and cannot answer a simple question as to where the company would be in the next five years, its survival is likely to be threatened. It is regretting that there is hardly any long-term planning in small and medium size companies which is, perhaps, primarily due to the fact that the executives of such companies are so overloaded with the burden of daily routine that they hardly have any time to plan the company's future. This situation, if it is allowed to continue, will only lead to mismanagemet of valuable resources which, in turn, will lead not only to disastrous nonsequences for the company, but will also undermine, by its accumulative effort, the nation's economy.

And yet, the planning process can be organised on a simple but systematic basis for any company, by drawing up plans for each of the constituent areas of the company's operation, viz., for marketing, production, finance, organisation, manpower, product development or for diversification. Though planning at all the above mentioned

Some Aspects of Company Planning

Ashoke Banerjee

The word *Planning* basically means taking decisions about things desired in the future—near and not so near—so as to avoid the happening of things which are merely the result of an accumulation of disjointed efforts. Planning is, thus, a form of anticipatory decision-making. However, planning is not the making of grand schemes for the future, without having regard to the resources that are needed to support such schemes.

Planning calls for a detailed and careful consideration of all the company resources, its strength and weaknesses, with a view to formulate explicit objectives and to decide the lines according to which the company should be guided. The company will have to break down this objective into its constituent elements by examining and testing the precise means by which the company will reach the desired goals from its present position. If, in the process, it turns out that some of the steps that are required to be taken are beyond the company's resources, then the plan has to be suitably modified.

The implementation of the plans are then monitored within the company

more emphasis should be placed on the marketing and the financial plans. Starting with marketing, the company must assess the likely demand for its product (s) and explore the possibilities of new markets for the purposes of diversification. The task of the financial plan is to translate a marketing plan into financial terms by projecting all the costs of resources required; money, material, men and machines to yield an adequate return on investment and to attain the marketing plan by ensuring that the company has the means to incur the costs on a continuing basis out of future income, while yielding a satisfactory level of profit. Therefore, the market is the basis of all plans which have to be matched by the financial plan which will show (a) that the resources required to attain the marketing plan will be available; and (b) it will yield more profits. Thus, when production plan is being formulated, it should be done in coordination with marketing and financial plans at the company level.

The next question that arises, is the time span of the plan. One thought is that the company should plan for the life of the investment. However, a period of more than five years is likely to be unrealistic for the simple reason that it is not possible to anticipate the likely changes beyond this period in the present-day dynamic conditions and it is nearly impossible in any case, to compile manufacturing data which could be used to develop the company in relation to market conditions. Basically, all small and medium size companies should make a short term and a long term plan—the short term plan being for one year and the long term plan for, say five years.

The most important is the annual plan which can be regarded as an action plan and must be worked out with a great degree of care. The whole plan must be compiled on the basis of cost and profit centres by involving the heads of these centres in the actual drawing up of the plan and then served by a Management Information System which will be presented continuously, say, week by week, to the responsible head of each cost centre, so that he can use this as a 'tool' for control purposes. The Management Information will show the variance between the achieved results from the plan which, then becomes the basis for prompt remedial action.

The planning process, to be of any value, must be a continuous process within which the company works is continually

changing, the plan itself has to be updated at regular intervals. The logical steps involved in a company's planning are :

(a) analysing the existing situation;

(b) setting clear objectives;

(c) selecting the most favourable strategy out of a number of alternatives;

(d) drawing up individual plans for sales, finance, production, project development, manpower, organisation;

(e) checking the individual plans against the financial plans resulting in the desired levels of profit and the need for additional finance;

(f) integrating the various plans into a master plan;

(g) working out detailed action plans, cost centre-wise;

(h) budgeting and comparing actual performance against budgets at the end of each month or preferably, each week;

(i) modifying or taking remedial action in the light of information revealed by item h above;

(j) setting new individual plans.

The company's appraisal will have to be sub-divided into (i) the current situation and (ii) the future situation. The appraisal of the present situation will be in respect of the market, the company and the competitors.

Market Plan

A clear understanding of the market in which the company's products are sold must be acquired—its size, its segments and the factors that influence the customer's demand for the company's products. As the company's share of the present market must be carefully considered, the company must know what is the customers' appraisal of the company's products and how good is the company's performance and what it would be in future. The company must know its own strength and weaknesses in respect of manpower, finance, products, product development, technology and sales. The company must also

be aware of its competitors and about their share of the market and about their strength and weaknesses in the areas of finance products, etc. As regards future development, the company must ascertain how the market of the future will be influenced by changes in customer habits and their requirements and how the demand would grow. The company must try to project the future prices, costs and margins and the likelihood of new suppliers.

The company planner should carry out a study into the future opportunities of the company's share in the market on the basis of its present operations under varying conditions, such as modernisation of products, as a consequence of technological change of extension of the product range, as a consequence of intensification of sales effort. The planner should also consider what changes in sales strategy would increase sales—either by opening up new sales channels or intensifying sales efforts in certain segments or by improved direction of sales force. In these situations, consideration has to be given to additional resources that will be required in terms of additional finances, better production facilities, manpower planning, etc.

The most important task in planning for the future is to establish clearly objectives, which are by and large, concerned with increase in profitability by way of increasing turnover. Here, the company is involved in decisions connected with a fast growth rate which has certain advantages and also dangers. The advantages of growth through turnover are reduction in costs of production which enables the company to withstand competition. Growth also enables the company to have easier access to capital and finance or more favourable terms. The dangers are that the whole organisation may go out of gear, leading to cash crisis, particularly, if the company is suddenly faced with recessionary conditions with reduction in demand. Therefore, growth objectives should be defined on realistic basis of achievable facts, such as a growth rate in turnover of 5 percent per year. The firm may also set other objectives, namely—bettering the return on turnover or capital.

It is important in any formulation of objectives that they are set down clearly and explicitly so that it not only creates the right psychological impact, but they are understood and accepted by the large number of managers who will be actively participating in the fulfilment of these objectives. It may take the shape of a concrete formula for increasing

turnover by 7 percent per year, or doubling profit in five years; or it may take the shape of attaining a leading position in industry in five years. The planning objectives could then be easily qualified in relation to turnover, returns, finance, production, stock control, manpower, advertising, sales and so on. One of the most important areas of planning should be concerned with the concept of rationalisation. One must look at one's current activities to see as to what extent rationalisation could reduce costs and increase turnover. The sales effort, for instance, could be classified by the ABC analysis of various products whereby every effort is put in pushing the sales where margins of profit are higher and withdrawing from sales those products which are either earning marginal profits or no profits at all.

Likewise, cost reductions can be achieved by improved flow of materials through work study and organisational methods study. Also, an important means of cost reduction can be achieved through value analysis. The cost savings achieved by value analysis could then be used to increase turnover by reducing prices or improved profits through improved margins. Substantial savings in fixed costs and in manpower costs could be achieved by taking a hard look at the areas of administration costs.

An important aspect of marketing strategy is the decision on whether a company should diversify its activities. Diversification means introduction of new products which will be sold to a new market or supplying the existing customers, products with new applications. A company embarks on diversification with certain objectives : (a) reducing the company's dependence on a limited number of products, markets, thereby improving the return on capital; (b) to cater to the needs of new markets where demand for its existing products are becoming stagnant; (c) to take advantage of its existing facilities, such as, a large sales force which is difficult to be sustained by its present scale of operations or to take advantage of its existing facility, or, where the product or its existing operations are dwindling because of excessive competition and it becomes a matter of survival for the company, to switch over to new activities.

In any diversification project, obtaining finance becomes a matter of crucial importance and as the early stages of diversification are time consuming the costs incurred on such projects have to be initially met

its return on capital. The company's return on capital should be established on the company's preparatory capital—i.e., equity and reserves. If the company is not currently earning an adequate return on capital, then it becomes the central and focal point of planning to consider means of improving it.

Cash flow planning is essential to the success if not the survival of the business. It must be continuously seen how the retained profits and depreciation are being used. The company must continuously watch and see that it has money to meet its commitments.

Liquidity planning is a part of cash flow planning to ensure that during the short term planning of one year there are no shortages of cash or where such shortages of cash are likely to arise, steps are taken in time to overcome them. The most effective way of ensuring liquidity is to introduce an effective cash management system. This is done by ensuring that the sales invoicing is done according to a laid down system whereby money is received by the company as promptly as possible by strictest adherence to credit term, making use of a discounting system which gives distinct economic gains to the company. The bank accounts should be strictly supervised according to a time table. So important is the need for cash management, that in many companies, it may be worthwhile to appoint a man wholly engaged in supervising all aspects of cash, which is managed according to clearly laid down procedures. There are various means of improving the liquidity position : (a) deciding on hiring rather than buying; (b) foregoing support services in the company such as owning cars, data processing by hiring such services; (c) deferring capital expenditure; and (d) rigid control of stock and inventories. All these are important measures and should be a part of any company plans.

It is also necessary to plan the measures needed to meet the company's future capital requirements. The assessment of capital needed and the time when it is needed should be established well in advance. Various factors must be considered in planning for capital, viz., (a) inflow of funds from trading profits and depreciation; (b) dividend policy ; (c) capital expenditure for present activities; (d) capital expenditure on an expansion programme; (e) capital from existing resources; and (f) resources to meet the shortfall of capital.

As far as existing operations are concerned, additional capital is required primarily to obtain increase in production facility to meet increasing demand or to provide facilities which will improve the efficiency of existing operations. Here, consideration has to be given for meeting working capital requirements. Additional capital may also be needed for rationalisation of the company's existing operations.

The capital requirements for new products (diversification) must be examined with the greatest degree of skill and care, because these requirements call for large substantial outlays of capital in creating new production facility. Likewise, adequate provision must be made to raise the working capital needs for raw materials, stocks and debtors and the running in costs, until the breakeven point is reached.

Capital investment decisions, at the very outset must be based on sound business judgement. Various alternatives must be evaluated and the best alternative selected, which would yield the highest return on investment on a long-term basis.

Manpower Planning

A company should also carry out proper manpower planning to ensure that suitable and adequate personnel are available to meet the company's requirement of the future. The company should also provide management development plans, which will develop employees with management potential for bigger jobs in the future. Manpower managing plays a key role in company's planning and the most important aspect of manpower planning are :

(a) to establish the manpower required in terms of number, qualification, age ; (b) to appraise staff in the middle and senior level. (c) to forecast the future requirement of manpower by number, qualification and age; and (d) to have a proper recruitment and training and dismissal policy.

Organisation of Company Planning

A company with a substantial turnover (say, over Rs. 10 crores) should have a separate planning section that will be responsible for assembling

data, co-ordinating individual plans and doing various preparatory work, in respect of decisions that have to be taken. The planning section, may constitute of one person who will be called the company's planner, and is answerable to the Managing Director. His responsibilities would be :

(a) assembling and evaluating data about the market and the company.

(b) information management about (a) above;

(c) submitting concrete proposals as company's objectives;

(d) testing proposals for extension of the product range for diversification;

(e) checking proposals submitted by other departments;

(f) integrating various company plans into one master plan;

(g) preparing an annual action plan on the basis of various budgets;

(h) advising on the variances shown by a comparison of the achieved results with the plan;

(i) subsequent modification of the plan as a consequence of (h) above.

A company plan takes time to produce results. The tasks involved in planning process are numerous which have to be executed with great deal of skill and care. To begin with, planning should preferably commence with areas such as marketing and finance. Later, as the planner gains more confidence as a result of success, he may enter into areas of production and manpower planning and then, into the total planning process.

To conclude, though planning is a long-drawn exercise, starting with each department and then planning for the company as a whole, it is indeed important for the survival of the company, and if planning faulters at any stage, there is every possibility that the company is out of the race.

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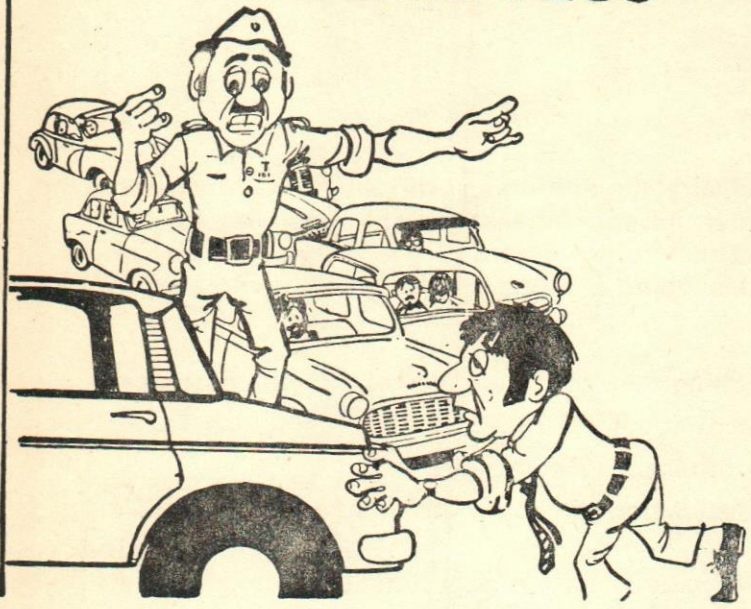

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Role of Research and Development in Business Growth

T. K. Mukherjee

Among all the business resources, knowledge is the most important. Physical resources without management are sterile and management without knowledge is ineffective. It is knowledge that distinguishes the successful company from the less successful one. Knowledge has become the central expenditure and investment of a modern economy. Capital flows in response to greater opportunities created by the greater productivity of new knowledge or innovation.

One of the fundamental characteristics of current life is that the whole pattern of ideas, concepts and attitudes, and the products, services etc., which stem from them are continually changing. Innovation plays a very major part in sustaining this continuing change, It is, therefore, one of the vital forces of this dynamic situation being responsible for the growth of the business, i.e., new products and services. No industry can assume that it will be immune from changes; and thus, to ensure survival and prosperity, all industries must, to some extent, be involved in innovating activities even if this is only to provide a counter-balance for those parts of their activities which are on decline.

The word 'Research and Development' is commonly understood in the context of technology, but it has a much wider connotation New technology is only a potential. It is marketing and, especially, innovative marketing that converts the potential into actuality. The areas for research and development are not restricted, but encompass the entire 'business activity': ideas, knowledge and need recognition occur in all branches of business, and thus, innovation can be developed from any point. Innovations may occur in the product, material manufacturing methods, distribution methods, storage methods, purchasing methods, sales methods, advertising methods, payment methods, etc. Innovations are, in fact, frequently sparked by the interactions of disciplines of activities. The purpose of this article is to examine the role of innovation in business growth in India.

Inter-Relationship of Economic Growth, Innovation and Human Resources

Agriculture, steel, automobiles, petrochemicals and electronics together have powered the tremendous growth of the western countries and Japan in the last twenty years. Agriculture played the most significant role in this growth. Agriculture has become the most productive, the most capital-intensive, the most highly mechanised of all industry. The 'input' of scientific knowledge has increased significantly. Agriculture has now become the most progressive sector from the most traditional sector.

A rapidly modernising agriculture not only produces the food without which an economy cannot possibly grow, it also creates demand for a great many new industries—from fertiliser to farm equipment, from equipment repair shop to farm credit, from transportation and roads to food processing—which, in turn, give high and well-paid employment. Likewise, the automotive industry creates a large number of jobs compared to those created in the manufacturing plants themselves—in road building and road maintenance; in petrol stations, repair stations and dealership, and so on. Thus, these industries create high immediate impact with great multiplier effect, thereby accelerating growth.

Furthermore, in the past twenty years, no single source had proved so rewarding and dynamic as a factor of economic growth as rising exports. Countries with the highest rates of growth of national income tend also to have the highest rates of growth of real export earnings. The capacity of an economy to grow was dependent on its capacity to export enough to pay for required imports and simultaneously export growth stimulates production for the home market. Increased export can only be sustained through increased output or productivity. The development and application of 'new knowledge' or innovation has created greater output or productivity in the modern industries

But this progress would not have been achieved, but for a massive build-up of human skills and talents followed by a growth strategy which made intensive use of these talents as industrialisation accelerated. This strategy of economic growth consistent with the human development goal has resulted in accelerated growth with improvements in

the share of income to the poor. With this background in mind, we can now turn to the Indian scene.

Indian Scene

Indian economy has long been characterised by a large traditional sector and a small modern sector. In India, most people live, however, indirectly, through agriculture. Good crops, which create purchasing power in the hands of teeming millions, is the only assured route to high total demand. During the last two and half decades, agriculture has remained largely traditional. However, during the last few years there has been greater stress in increasing the 'input' of scientific knowledge to agriculture. But the adoption of improved techniques and the spread of new seeds and fertilizers cannot by themselves bring about self-sustaining growth in the farm sector. The human resource development should be stressed so that the benefit of technology is not confined to elite farmers but spreads deep into the entire segment of rural population. Thus there should be greater stress on rural human resources development rather than technological innovation alone.

Coming to the industrial arena, one finds that there has been significant increase in capacity and widening of industrial base. There has been increased indigenous supply not only of manufactured goods but also of raw materials and equipments. The growth of industries has so far been based on import substitution, i.e., stressing replacements of imports with domestically manufactured goods. Import substitution policy encouraged protective domestic market and worked as disincentive to explore competitive export market. Exports, which stimulated the economic growth in the developed countries, was reluctantly accepted by industries, due to government compulsion : In a shortage situation, products sell by themselves but in a competitive situation one has to create demand or practice 'innovative marketing'. With the sudden change to surplus situation, industries are finding it difficult to sell goods even in domestic markets. This change was hardly visualised, which indicates the lack of business vision. The reason for the illness of many industries is not due to lack of finance, obsolete equipments or products, but due to lack of ideas or knowledge of what is happening and what is going to happen. This is the fundamental constraint on growth.

Furthermore, the policy of industrialisation was not combined with human resource development to absorb the benefit of technology and also to create employment opportunities. Import of technology or development of indigenous technology will accrue benefit to none, unless it is simultaneously combined with major investment in development of human resources with subsequent creation of productive employment opportunities. It is just not enough to create R & D centres to develop technological skills, neglecting development of total human resources. It is the aspiration and ideas of people which is the greatest stimulant to growth. Furthermore, the technological innovation is inert by itself, unless, it is combined with innovation in other areas of business. Hence, growth cannot be sustained through technological innovation alone.

Management of Talents

For business growth, one needs to make productive the fundamental resources, i.e., human resources. We have to attract the human energies of a society into growth opportunities. One needs to multiply talent.

Leaders or owners of industries will have to learn to build and manage a human growth which is capable of anticipating needs, capable of converting vision into techonolgy, products and processes and willing and able to accept new ideas. They will have to learn to manage in innovative organisation.

The innovative organisation needs a new aptitude on the part of the people at the top. In a typical organisation, the top people sit in judgement. In an innovative organisation it is their job to encourage ideas and to try to convert the largest possible number of ideas into products, services or purposeful work. To accelerate growth, we must multiply talents and capital and this must be built into the country's economic strategy.

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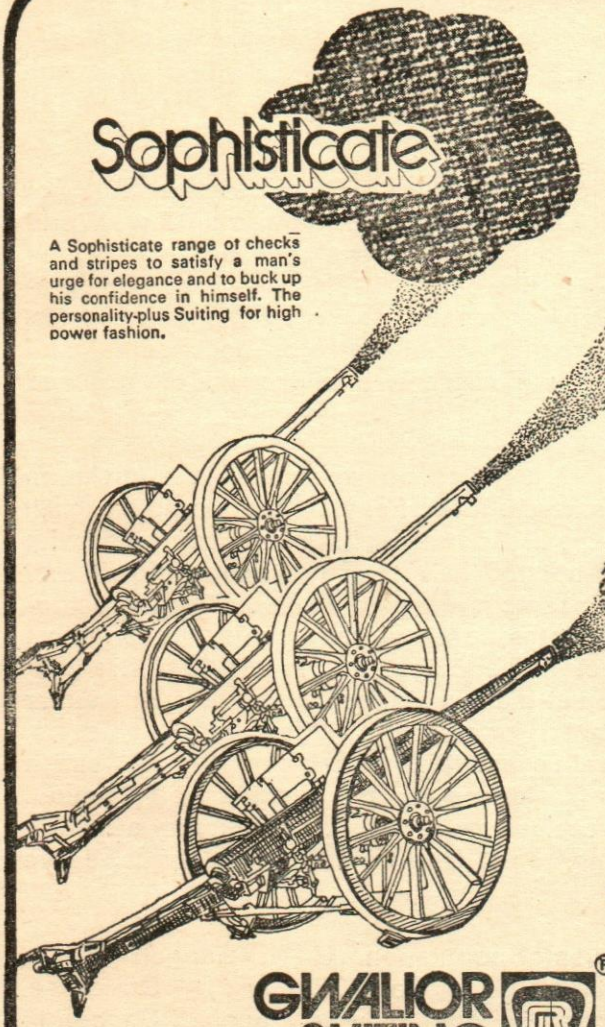

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Book Reviews

Population in India's Development 1947–2000

(Edited by) Ashish Bose, Ashok Mitra, P. B. Desai and J. N. Sharma,

Vikas Publishing House, Delhi, 1974, xix+474, Rs. 60.00

Reviewed by V. S. Mahajan*

This book is sponsored by the Indian Association for the Study of Population (IASP) and is India's contribution towards the World Population Year (1974). It contains about thirty-six papers contributed by specialists from different fields like census administrators, demographers, economists, engineers, environmentalists, family planning experts, mass media experts, medical doctors, social workers, sociologists and statisticians. For the convenience of readers, these papers are grouped into seven parts.

Part I is introductory. Ashok Mitra writes on approach to population under different Plans. He laments the lack of any systematic policy. "All the five-year plans, right from the first onwards, have been contented with merely setting the desirable targets of the rate of population growth and refrained from discussing the possible ways of manipulating the demographic variables of births, deaths, and migration and the principal economic and social means of influencing them. In the first five-year plan... no attempt was made to set the targets for limiting mortality either by age or sex group like prenatal, infant and childhood mortality levels, maternal mortality by age parity and differential mortality by cause of death or by rural-urban residence or by geograhpical region. Neither have these topics received more than a perfunctory attention in each of the subsequent plans." (p.9) One would, by and large, agree with what the author says.

Part II is devoted to wider issues of population. B. N. Ganguli speculates on the future quality of India's population (Chapter 2)— Of course, considering the poor data base it could only be a guess. Ganguli is against India aping the Western technology and would like the country to develop technology which befits her social environments and helps

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to enrich the quality of life of her people. Pranab Bardhan contributes an interesting paper on inequality of income (Chapter 5). Like Ganguli, Bardhan is also of the opinion that extensive use of borrowed technology would generate social tension, increase unemployment and widen income inequality. However, at the end of his paper he strikes a hopeful note of new technology, "Most of the purely economic projections into the near future are not very hopeful in terms of mitigation of unemployment, poverty, and inequality. These projections are usually based on the assumption of a given social and political framework. But, it would be wrong to underestimate the countervailing power of changes in attitudes and aspirations of the poor and their politicization and communications .. The process is painfully slow, but the most promsing change that is already taking place is that the rituals and institutions which for centuries essentially legitimized inequalities are losing their social and political sanction." (p. 73) One, however, wonders how far the new social framework is emerging because modernisation is an improvement over the one being discarded.

C. Gopalan tells us, in his paper on nutrition (Chapter 8), that by 1984-85 India would be having an excess of cereals to the tune of 50 million tonnes and of sugar 14 million tonnes (over national consumption), but it would be deficit in vegetables (by 58 million tonnes), in milk (by 21 million tonnes), in fats and meat (by 15 million tonnes). However, looking at the current demand pattern, it looks doubtful whether the country would be able to create surplus of cereals and sugar to the extent predicted by Gopalan. Shanti Ghosh and Tara Ali Baig (Chapters 9 and 10 respectlvely) complain that child care in this country has been a neglected subject. It is true that while the country is saddled with the world's largest population (among democratic countries), the planners have throughout neglected the problem, nor child care finds an honourable place in the medical education.

Part III is devoted to resources. While Hari Narain, T. K. Roy and T. L. Sankar deal with natural resources (Chapters 11, 12 and 13 respectively) minerals and energy respectively, V. S. Vyas presents a thoughtful paper on land use (Chapter 14). There is no gainsaying the fact that the country has failed to tap its resources for maximising production and this, in turn, would have helped in reducing poverty. While the government should intensify search for new resources, it should also see that the known resources are effectively tapped for

increasing production. Even in land resources, as Vyas points out, there is ample scope for multiple cropping, as hitherto only 17 per cent of the land has been sown more than once. But multiple cropping requires a package of inputs where India continues to be quite deficient. Part IV is devoted to the role of population in economic growth. It deals with topics like population under planning, population projections, employment and labour force; and includes contribution from J. N. Sinha, A. Ghosh, among others. Part V is devoted to migration and urbanisation. Mortality, fertility and family planning are dealt in Part VI. Part VII is exclusively devoted to population statistics and projections.

The book on the whole is well-edited, documented, supported by facts and figures and makes a thoroughly refreshing study. The ISPA has indeed done a good job in bringing out this timely publication which should be read with interest by demographers, researchers and policy makers in particular, as well as by the general readers. We are told that the ISPA intends to bring out an abbreviated edition of the book in other Indian languages. This is a welcome future.

Money, Banking, Trade and Finance

K. P. M. Sundharam
Sultan Chand & Sons, Delhi, 1974, Price Rs. 17.00
Reviewed by N. Varadan*

The author must be congratulated on bringing out diverse areas of specialisation in one book. The treatment gives a comprehensive coverage under each branch of Economics/Banking.

Part I deals with Monetary Economics; Part II speaks about the theory of Income and Employment; Part III addresses itself to Banking and Financial Institutions; Part IV covers International Trade and Foreign

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Exchange; Part V throws light on Indian Currency and Banking and Part VI highlights Public Finance.

It is clear from the above that a link is sought to be forged between Commerce and Economics and at least the author has paved the way for the same. The only Chapter which does not fit in well with the scheme seems to be the one on Indian Currency and Banking. If this chapter had been omitted, space would have been available to incorporate the latest and advanced material under each heading so as to be useful for the post-graduate students and which could be put under 'Appendix'. For example, much water has flowed under the bridge with regard to the consumer behaviour, quantity theory of money, International trade, world monetary crisis and federal finance. In fact, the concept of international liquidity undergoes a sea-change now and then, that by the time any text goes in print, it becomes obsolete. Milton Friedman, has recently embellished the quantity theory of money and Jagdish Bhagwati seems to be revolutionizing the theory of international trade.

With regard to the above, the author has not given the treatment it deserves. Perhaps, this is meant to be a textbook for the undergraduate students.

The following matters require a more elaborate treatment : Inflation; Keynesian Theory and Under-developed Economies; Modern Theory of International Trade; The International Monetary Fund and International Liquidity; Public Expenditure; Federal Finance: Fiscal Policy, etc.

The material on the above seems to be very scanty. Bearing in mind, these are the 'marks-yielding' topics, the author will do well to concentrate on these areas instead of treading the beaten track of the history of Indian Currency and Banking. We prefer currency to history. Let by-gones be by-gones. What is happening today matters most.

Problems of Development of Smaller Countries

Dr. Y. P. Pant

Published by Oxford & IBH Publishing Co., 66-Janpath, New Delhi-1. 1974
Pages 222. Price Rs. 35.

Reviewed by N. C. Joshi*

Starting off with a description of the structural characteristics relating to the smaller countries of Asia, Africa and Latin America—all put together, the author proceeds on to examine some micro aspects like transport, financial resources, marketing issues, industrial development, external aid and regional trade pacts. Besides, a separate Chapter is devoted to evaluating the common peculiarities of about twenty five land-locked countries of the world.

The major stance adopted by the author is that the inflow of foreign assistance to smaller countries needs to be channeled through the U.N. and other multilateral agencies. It is suggested that "less emphasis be placed on bilateral aid, so that external aid can be made to suit the aid-receiving country's needs and the long-term development goals." Smaller countries being also the least-developed countries, a plea is made for concessional and increased financial assistance along with more flexible criteria for project evaluation.

The author points out that there is no internationally organised system for determining need priorities among developing countries. As such, aid from individual countries get neither coordinated nor marshalled for its optimal utilisation. Tariff barriers and quantitative restrictions imposed by advanced countries have created a lower capability for smaller countries in improving their export trade. Their import needs being inelastic, the foreign exchange earnings are always under a threat of quick depletion. It was perhaps in appreciation of the weak situation in which small countries are placed that the U. N. approved in 1971 a list of 25 'hard core' least developed nations the majority of whom are

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also smaller countries. The UNCTAD is working out a detailed action-oriented programme for their economic emancipation.

Dr. Pant further asserts, and rightly so, that the absorptive capacity of these countries is the basic constraint for utilising foreign assistance optimally. He believes that if technical assistance is integrated with financial assistance, it would help in consolidating the absorptive capacity to some extent. It is, however, necessary that research studies be made to delineate areas and methodology for impregnating the so-called limited capacity of smaller countries in the matter of development.

In the process of focussing on the major issues of development, the author also suggests a kind of regional integration on the part of developed countries in giving aid so that competition amongst small countries is avoided and uneconomic plant installations are not created in individual countries. 'Within regional groupings, the relatively less developed countries can be provided with technical assistance by the more advanced member countries in implementing feasibility studies, planning and programming of industrial projects, and the training of skilled personnel including the establishment of institutions of economic planning for these countries." It is true that most of the smaller countries are too small and too little developed to be able to achieve signficant results when they act independently.

While asking the smaller countries to go ahead with full determination the author ends up with an optimistic note when he says that the prospects for economic and social development of these countries could be promising when they endeavour on a more sustained basis. The book does a neat job of bringing to light the complexities and dimensions of the problems of development that smaller countries of the world face today. It also usefully covers the ground in pinpointing the crucial instruments and realignments that are needed for their development.

Agricultural Prices in a Backward Economy

R. P. Gupta

National Publishing House, Delhi, 1973, p. 238, Price Rs. 40.

Reviewed by S. M. Pandey*

This book is based on a study on the behaviour of the agricultural prices. Although it covers a period which is several years old, it might be helpful in providing an understanding of the behaviour of agricultural price system in an agriculturally backward state of India, viz., Madhya Pradesh.

The study consists of eight chapters. First two chapters deal with the general economic background of agriculture and marketing environments for agricultural products in Madhya Pradesh. Chapter III analyses the problem of supply response to price in agriculture in the underdeveloped countries. Chapter IV focuses on the supply response to prices in agriculture in Madhya Pradesh. Chapter V deals with the seasonal variations in the agricultural prices. Chapter VI examines the pricing efficiency of the marketing system in Madhya Pradesh. The problem of marketable surplus and the linings of market arrivals have been studied in the chapter VII. The concluding chapter assesses the findings of this study and policy implications of it.

The study shows that the price is not a major factor in determining the acreage allocation amongst various crops in Madhya Pradesh. The rate of increase in area under crop was more in respect of those crops which have less variability in prices over time. The farmers seem to give importance to those crops which have greater protential for increasing productivity. The above conclusions need further probing through carefully planned studies in different settings. In particular, much is left unexplained as to why "the models of farm supply which have been found to work in other parts of the country breakdown" when applied to data for Madhya Pradesh. Likewise, there is a need to analyse and quantify the relative significance of inputs such as credit, irrigation,

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fertilisers and high-yielding seeds etc,, in influencing the acreage allocation under various crops as well as their productivity.

This reviewer feels that though the study has thrown up some interesting findings, at times one comes across some shortcomings of methodology. A more thought-out and clearly specified relationships and functions would have enriched the study considerably. The author finds that there is no positive relationship between the production and its market arrival. On the contrary, the market arrivals are reported to have declined when the production has increased. There might be many important factors responsible for this phenomenon, and one cannot undermine the inaccurate reporting of the data on market arrivals.

On the whole, the study should be useful to those interested in understanding the mechanics of agricultural prices in a backward agricultural economy. The findings of the study might serve the purpose of working hypotheses for further studies on the subject.

Agricultural Extension : A Field Study

Arun Mukhopadhyay

Minerva Associates, Calcutta, 1974., pp. 236, Rs. 40.00

Reviewed by P. L. Mehta*

The auther starts by explaining the concept of extension as "a kind of educational process particularly designed to suit the socio-economic condition of rural communities". He goes on to say that "...the pattern of services is ultimately determined by the prevailing forces in rural areas of a particular country". It is exactly in the exposition of this aspect that Mukhopadhyay does not seem to fathom the depth required by his statement. Except at a few places, his analysis does not link the rate of extension services and their impact on the socio-economic structure. His treatment of the socio-economic aspects in the present context seem to me to be shallow.

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The book relates to Jhargram block in Midnapore district of West Bengal. Leaving out the introductory remarks, the book can be divided into two portions, one dealing with input pattern and the other analysing output pattern. The former includes socio-economic factors (like population, occupational patterns, land-man ratio etc.) and the techno-economic variants (like land, capital, irrigation, technology etc.). The output-pattern tries to correlate the farm size, and tenurial groups and traditional as well as non-traditional inputs with the average yield.

He portrays the Jhargram block as essentially an underdeveloped agrarian economy with a large majority of population near the subsistence level. Its traditional agriculture is combined with the lack of capital. The family size is seen as rising overtime. Majority of the people are illiterate. The lowest 38.5 per cent households have only 13 per cent of the land. The village economy in the region is virtually self-sufficient and a large portion of it is non-monetised. Irrigation is quite inadequate. Seed management is unsystematic and chemical fertilisers are not very popular because of the inadequate purchasing power and risk of income response. And, the more interesting in the present case, the majority of farmers are indifferent to Block recommended farm practices—a normal phenomenon of slow speed of innovation in underdeveloped societies.

Mukhopadhyay rightly brings out the phenomenon that "small farmers whose non-agricultural family income is of significant amount are more inclined to invest it (the surplus) on purchase of land than on employment of stock of both durable and non-durable capital assets for intensive cultivation"..... and that medium farmers having some surplus potential (which is rhythmic with seasonal pattern seem to be affected by the Dusserbery type consumption behaviour", while the rest of the population is too poor to afford the new technology. Further, 70 per cent of the rural credit comes from non-institutional sources, with all its drawbacks. He successfully projects the divergence between the interests of rural credit cooperatives and non-official credit coopetratives. This divergence reflects the conflict of interest between the two in the sense that the latter wish to monopolise the credit institutions and perpetuate the prevailing credit conditions in the region. If one looks at other regions in the country, one finds the failure of their official credit cooperatives is largely as a result of the pressure of the official credit cooperators. The author has tried to bring out the

role of big farmers towards the cooperatives development, both within and outside these cooperatives.

According to the author, the share cropper's land has the highest average rate of yield; while in terms of quality of land "the landless farmers have received worse type of land of their own". Rate of yield moves with the amount of availability of rain water.

Mukhopadhyay kicks up a much-debated issue, when he says that agricultural activities are insensitive to market prices which are distinct from inter-village domestic prices. He seems to be right here, as what he is studying is a traditional, subsistence level, self-sufficient agricultural economy, where majority of the people have negligible marketable surplus as they have adequate produce for their own subsistence only, and their sales, if any, are distress sales, which do not link them to market forces either.

On the whole, the book is a good attempt on analysing agricultural extension services in the region. To a large extent the analysis is applicable to most of the parts of India, in one form or another. The language is lucid. This being a field study, it is likely to be quite interesting, authentic and revealing.

New Books : Annotated List*

An Introduction to Managerial Finance

Bierman Jr., H. & Hass, J. E.

London, Pitman, 1975, 294 pp, £ 3.75.

This book is an attempt to teach introductory business finance using basic mathematical models. Some of the models will help the overall understanding and some will lead directly to improved decision-making by supplying optimizing techniques that may be applied to problems. The book is divided into five parts that parallel the contents of many managerial finance texts: 1. The fundamentals of financial management, 2. Current asset management, 3. Financing strategies and the costs of raising capital, 4. Investment decision-making under uncertainty, and 5. Special topics. In each of these areas, the book extends the material presented by introductory texts, deriving mathematical results that are generally consistent with the verbal discussion found in them.

Econometric Methods

Dutta, M.

Cincinnati, South-Western Publishers, 1975, 382pp, $ 10.75.

This book is written to aid would-be econometricians in preparing themselves for further advanced studies. First, the book emphasizes the role of econometrics, focusing its attention on how to measure the unknown parameters of models that may be constructed to specify an economic system or a sub-system, as inter-dependence of economic activities has been underscored right from the beginning. Secondly, the book makes an effort to explain successive steps relative to the discussion of each subject. Thirty, problems related to econometric studies, such as heteroscedasticity, serial correlation, multicollinearity, lag structure, instrumental variables, and consistent estimators for an interdependent system, have been discussed at length.

*Prepared by Mr. S. N. Vig. Documentation and Information Officer, National Productivity Council, New Delhi.

Effective Marketing Logistics

Buxton, G.

London, Macmillan, 1975, 244pp., £ 10.

The basic ideas inherent in the marketing logistics concepts, and to show how these ideas can be put into practice within a framework of planning, implementation and control is the basis of this book. The emphasis is on the application of concepts and techniques within a managerial context. Part I introduces the reader to the meaning and significance of marketing logistics and lays the foundation for a more detailed analysis of the component elements of logistics strategy. Part II examines specific aspects of marketing logistics strategy, and contains four chapters devoted to retail and depot location; inventory management of warehousing; materials handling and transportation activities. Part III combines the above two to develop a managerial framework for the implementation and control of marketing logistics strategy. Behavioural issues are considered as attention is directed towards the problems of communication and organisation at both a functional and corporate level. The final part devotes to case studies designed to illustrate the major ideas presented in the book.

Human Relations in Business (2nd ed.)

Carvell, F. J.

New York, Macmillan, 1975, 408 pp, £ 7.15.

This book is about the way people interact with the social, organizational, and human elements they encounter in the work environment, directed toward upper-level and top positions in an industry. The second edition contains several new topics and revised versions of many topics covered in the previous edition. A great deal of attention has been paid to the intri nsic nature of work and its contribution to job satisfaction. The impact of management philosophy on organizational climate has been explored and a new section has been added on the use of participation as a strategy for change. More material has been included on group processes and the topic of communication has been expanded to include more information about nonverbal and symbolic communications as they affect the interaction of workers and their supervisors. As in the first edition, much of the content of this book is a capsulization of existing theories and concepts

of human relations. There is no concerted attempt to expound new or unique concepts of management.

International Dictionary of Management

Johannsen, H. & Page, G. T.

London, Kogan Page, 1975, 416pp, £ 10

This dictionary is a practical guide and reference work to the language of management. The 5,000 entries cover not only the terms and jargon of business and management, both in theory and practice, but also deal with the broad environment in which the manager operates. The dictionary thus not only defines the specialized terms covered by such areas as business and commerce, investment, finance, production and works management, personnel and training, employee relations and industrial relations, marketing, management accounting, office administration, data proceesing, research and development, purchasing and distribution, but also includes many terms in related subjects such as economics, law, sociology and statistics which impinge on the manager's work.

Investing in Value

Warburton-Brown, D.

Tokyo, Asian Productivity Organisation, 1975, 164pp.

The benefits which can be realised from the use of Value Analysis/Value Engineering technique are very great. Many examples based on recent experiences in Asia, Europe and the United States are dealt with in this book which clearly indicate that these techniques can be applied with success in widely differing types of industry. Emphasis is also placed on the importance of discipline, hard work and, equally important the need to cultivate an attitude of mind which, through questioning, and challenging, is able to grasp the fundamental issues involved in any situation quickly. In an atmosphere of rapidily rising costs of both materials and labour, profit margins are diminishing and no commercial undertaking can afford not to ensure that maximum value is realized for each monetary unit expanded. This book shows not only what can be achieved but also the way to ensure maximum benefits.

Management of Small Business

Grieco, V. A.

Columbus, Merrill, 1975, 360pp., $ 11.95

Some businesses are successful, while others fail. The number of failures show that the knowledge of approaching businesss is of utmost importance. Questions appearing after each chapter in Part I are of two types: those which can be answered from the text material, and others which require research are intended for project-oriented instructors who can direct students to some interesting experiences. The incidents contained in Part II of the book are designed for specific discussions of management practices. Part III of the book contains case materials. All are based on true cases made possible through the co-operation of business firms. They are illustrations of both effective handling of varied management situations by small businessmen and women.

Organizational Behaviour Modification

Luthans, F. & Kreitner, R.

Glenview, Scott, Foresman & Comp. 1975, 214 pp., £ 2.60

The focus of this book is on observable organizational behaviour and the external environment rather than on the individual's internal motivational state. Organizational behaviour is a function of its contingent consequences. The authors do not believe that the study of motivation will lead directly to prediction and control, but they do believe that these are desirable goals for human resource management. Therefore, they have turned to operant learning theory and the principles of behaviour modification as a means of achieving better understanding, prediction, and control of organizational behaviour. The result of this integration is what they call organizational behaviour modification or, simply, O.B. Mod. The book consists of ten chapters. Chapter 4 presents examples of the five-step problem-solving model of behavioural contingency management (BCM). This five-step model (identify, measure, analyze, intervene, and evaluate) represents a specific application of O.B. Mod. for more effective human resource management.

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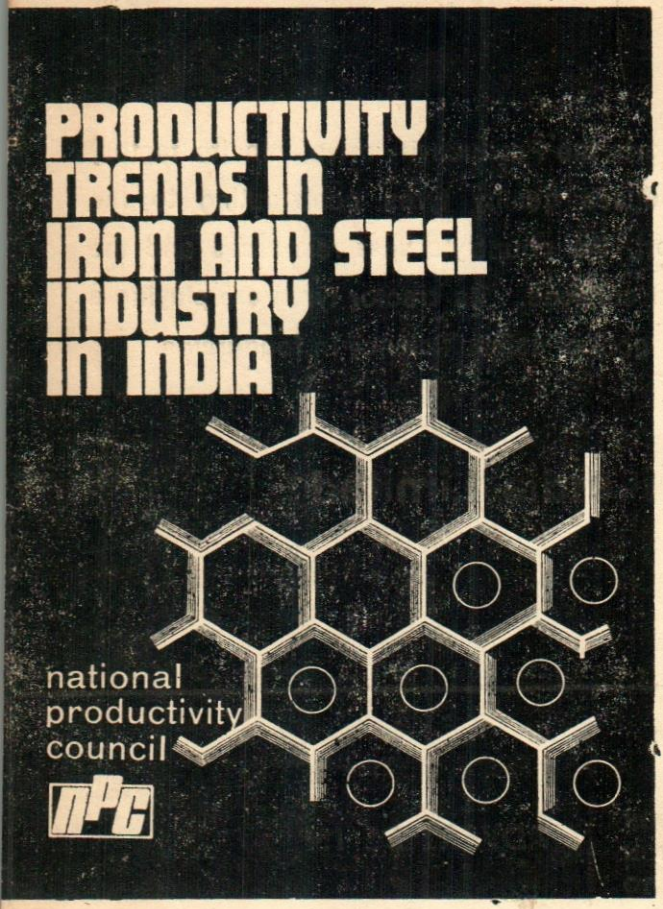

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