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PRODUCTIVITY

SPECIAL SECTION : APPROPRIATE TECHNOLOGY

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PRODUCTIVITY

ANNOUNCEMENT

Our forthcoming issues will have special Sections on themes : Women at Work; Social Responsibility of Business; Informal Sector; Ancillarisation; Productivity Agreements. Contributions of high Quality are invited.

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PRODUCTIVITY the principal organ of the National Productivity Council of India, is a quarterly journal for policy makers and professional managers. It disseminates knowledge on techniques and methods for improving productivity and enhancing economic growth through effective management in all sectors of the economy. In agriculture the preference is for issues dealing with post-harvest operation. Management is considered to include subject matter generally taught in a typical management institute as well as work in other fields that is applicable to management functions and practices. Thus contributions from a number of disciplines are accepted for publication. Manuscripts that present the results of original research and analysis are given priority. We also invite papers on business surveys, reviews, evaluations, and applications of new or revised business techniques or systems and those outlining management thought and philosophy.

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Letter From the Editor-in-Chief

Dear Reader,

Civilization owes its existence to its current values and the rapid technological developments which have taken place since the dawn of industrial revolution. The benefits of technology which were harnessed by the developed Countries have also started percolating to the developing Countries.

While there has been significant progress in attaining self reliance in several areas in India we are beset with problems of choosing the relevant technology. The choice of appropriate technology is required with the philosophy of socio-economic development, and it is quite relevant to identify the areas where foreign technologies are not needed because adequate indigenously substituted technology can be utilised for domestic industries using the same technologies.

The traditional technologies which have evolved through a long process of experience cannot be ignored resulting in colossal waste of local skills. In sectors like handicrafts, harvesting, leather goods, transport, processing of agricultural products etc., traditional technologies result in overall development of rural economies as it blends technology in consonance with a particular situation in respect of demand, dispersal of technical know how, organisation and mechanics of markets, operational skills etc. The appropriateness of technologies is governed by consideration of social justice and egalitarianism.

Commercial operations often justify the economies of scale. While "small is beautiful" is a good concept to encourage enterpreneurial skills, we would be in a disadvantageous position for key sectors; for example the biggest petroleum Company in USA has 22 times, the turnover of biggest Indian Company: in steel it is 6.7 times. Realising the advantages of large sized power plants, India has followed the suit only in the power sector by going in for 500 MU Thermal power plants instead of traditionally smaller units of 60 the 70 MU prevalent 10 to 15 years earlier.

The newly emerging disciplines of genetic engineering and bio-technology hold promise in future for several issues relating to human and animal health, fertility, agricultural production, energy and industrial micro-biology. It is believed that developments in the above area, would surpass achievements so far, India has done extensive research and development work of immense significance in genetics, molecular biology and immunology and our achievements have been recognised by UNIDO's recent decision to locate at Delhi the bio-technology centre to promote and disseminate research efforts.

The revolutionary micro-chip technology, robotized production, on line micro processor based control are catching worldwide attention. There is trend in favour of the latest fifth generation computer using very large integrated techniques incorporating improvements in optical lithography and chip formation. These computers would be powerful to understand human voice and would make programming language obsolete. In India as well, there has been a gradual change of opinion both by policy makers as well as industrialists on usage of computers to improve productivity of industrial operations. Cheap labour cannot match productivity improvements which can be attained by application of microprocessor based units. This technology holds immense promise to generate surplus, provides greater employment, generate services in marketing, procurement, and develop expertise of software engineers and

technicians. Adoption of these technologies however, is not problem free and requires development of operating skills, re-training to remove psychological barriers.

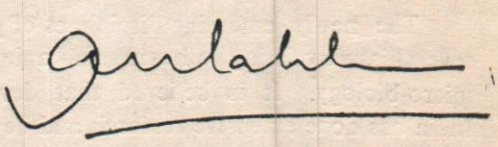
Over the years the environmental problems which are nothing but spin off effect of industrial activities have acquired special attention. Contrary to the common belief that environmental management is relevant to less developed societies as it would integrate technology with ecological, cultural, economic, social and other factors and enchance the quality of life in general, different strategies are being followed for protection of ecosystems, to encounter water and air pollution problems. It has become quite imperative that while selecting appropriate technology, this aspect at no cost is overlooked.

There is a wide gap between the levels of technology employed between developing and developed countries.

To improve the quality of our techological capability, it is important to increase opportunities of indigenous technological talent qualitatively. In the last three decades, there has been sizeable importation of technology into India. Over the years, a large number of collaboration agreements have been entered into. On the front of development of technology, through indigenous research and development, the outlay has grown substantially.

The gaps in technology are also discernable in products and processes. Primitive tools and techniques exist together with developed equipment and sophisticated functional methods. In India, we shall have bullock-carts and steam engine along with modern jets and satellites. The contrast between sophisticated units and old ones is far more striking even with the organised industry. The gap is strived to be overcome by upgrading the technology either through import or through domestic R & D or both.

In the existing situation, India has to carefully determine the thrust areas for a forward March sparing no efforts to import as well as innovate technology through R & D efforts. This is called for, to improve competitiveness and export market. There is a positive need to strengthen cooperative research. The weak areas having to be strengthened by co-opertive research efforts with linkages established between various agencies for demonstrating the improvements in a phased manner. The selective import of balancing technology to bring up Indian Industry to the levels prevailing in the other developed nations should be taken up expeditiously. The trends are clear and we have to make concerted efforts to selectively choose technologies which will give rapid productivity increases than what has been possible. The science and technology policy recently enunciated if adopted to the logical conclusion would undoubtedly bring about the desired change. Are we ready to accept this challenge !



(A. N. SAXENA)

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Unemployment, Technology Choice in Developing Countries

KARL WOLFGANG MENCK

If developing countries learn to draw attention to the necessity of job creating technologies, developed countries' strategy to support the latter's research and development efforts is a most promising way to enlarge the stock of labour-intensive technologies and to improve the conditions for their application. Also efforts should be made to define and initiate technical assistance project which transfer labour-intensive technology on a large scale and contribute to the employment generation in the Third World countries.

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Unemployment in developing countries

Recently published reports on developing countries' situation state that about 300 million people lack employment. This figure does not include the phenomenon of hidden unemployment which is also common to most developing countries. It is estimated that about one third of the total manpower of these countries belong to this group. According to the International Labour Organization around 30 million people will enter the world's workforce annually up to the year 2000 or about 120.000 jobs per day.

Exports in developing countries and developed countries refer manifold reasons for unemployment which—obviously—did not decrease although considerable efforts were announced and undertaken. Often it is argued that the growth rate of population exceeds the rates of economic growth. Therefore economic growth failed to meet the challenge of job creation. Other deliberations stress the inadequate progress in industry and agriculture to cope with the problems of unemployment. Another explanation runs as follows: since many developing countries subsidy capital-intensive technologies by concessional interest rates and minimum wage rates—irrespective of the labour productivity, investment did not contribute to the solution of the unemployment problem in the Third World. Development strategies are also blamed not to contribute to job creation. Targets

of economic policy stress other purposes than employment generation, and even import-substitution or export-promotion strategies are not pursued in a way which would enable to set up additional job opportunities. Also it is assumed that protectionism and economic policies which interfere into the free trade of goods and services and the movement of capital obstruct adjustment processes in developed and developing countries. Rigidities are not removed which are sources of unemployment.[1]

Empirical studies point out that a direct logical relation between unemployment and different reasons cannot be deduced with a reliable accuracy. Reports of the World Bank and of economic research institutes assume that more or less all of the explanations mentioned above have to be quoted as causes. There is only a very slight chance to prove that lack of job opportunities arises from the marginalisation of the Third World due to structural dependence, as it is outlined by the dependencia—theorists and thereon based explanations. Moreover it can be concluded that reduction of population growth, economic growth oriented development policy and structural adjustment are alternative instruments to overcome problems. In any case, it is also recommended that labour-intensive technologies should be considered in a manner appropriate to the microeconomic context.

Job creation by labour-intensive technologies

E.F. Schumacher[2] was in the early seventies one of the most prominent advocates when arguing that jobs in developing countries should be made available by another technology than that which is common to developed countries. This proposition stemmed from the experiences gained during the First Development Decade of the United Nations. Although economic growth was considerable, the unemployment situation after that decade was far more worse than before. E.F. Schumacher's conclusion said that technologies had been transferred by development assistance which were not appropriate to the developing countries. A radical shift had to be brought about in order to curb the problems arising from the uproar of the jobless and to prevent social costs which might be initiated by conflicts between employed und unemployed. As an alternative for the future E.F. Schumacher and his followers recommended to apply labour-intensive technologies as more appropriate. Further advantages of such technologies were that processes fitted to the economic, technical, cultural, social and political environment and thereby did not produce imbalances or distortions. Finally, as another advantage it was perceived that this know-how permitted a participation of the population in developing countries and thereby strengthened national capacities in the developing countries.

Such technologies, which have been described as intermediate, appropriate, adapted—to quote only a few of the most common terms— had to be worked out either by an upgrading of skills which existed in developing countries through local efforts and—if required—with a support from industrialized countries or by a downgrading of technologies available in developed countries. Immediately after E.F. Schumacher had outlined his proposal, a very intensive discussion on the appropriate technologies and their generation started. Some institutions, especially voluntary and non-governmental development organisation, set up the administrative and technical framework to develop appropriate technologies. As a result, at the beginning of this decade there is a wide array of devices for appropriate technologies. Most of the blueprints have not been tested yet and/or are not applied. Results of the controversal analysis of the concept underlying the idea of appropriate technologies did not contribute to the operationalization of the term appropriate technology, but shed light on its different aspects and outlined the problems of definition, selection and application of such technologies.

Since priorities of development were shifted according to a change of preferences of politicians in deve-

1. cf. R.M. Sundrum, Development Economies. A Framework for Analysis and Policy, Chichester, New York, Brisbane, Toronto, Singapore 1983, p. 37 and more; W. Ochel, Die Entwicklungslander in der Weltwirtscraft. Eine problemorientierte Einfuhrung mit einem Kompendium entwicklungs-theoretischer and-politischer Begriffe, Koln 1982.
2. cf. E.F. Schumacher, Small ist beautiful. A Study of Economics as if People mattered, London 1973.

loped and developing countries, the not yet unclassified term appropriate technology was open to further contributions and not compatible redefinitions. After the first oil-shock in 1973 it was suggested for instance, that appropriate technologies should also be energy-saving. When later on tensions between ecology and development became obvious, it was assumed that such technologies should also protect environment. After the strategy of basic needs had entered into the development experts' considerations and into the international debate, it was also envisaged that appropriate technologies were an instrument to care for basic needs and to guarantee participation of the poor. As a consequence, the definition of appropriate technology was not at all any more clear and operative. Instead of that, it was a black box which contained all flashlights of thinking in the development policy without considerating whether this addition of criteria were compatible or not. One of the proposals which was never dismissed remained that such technologies should create job opportunities based on the local technology.

It should not be concealed that appropriate technologies were not appreciated by developing countries in general. There was a widely-held suspicion that the technological gap between industrialized and developing world should not be bridged but continued with a transfer of a second-hand technology. Also, it was felt that the economic and technological implications were not at all simple and cheap. One argument, for instance, said that the introduction of appropriate technologies was hampered by the lack of capital in small-and medium-scale industries since the outlays for simple machinery exceeded the saving and credits' access of the target group. Also, technical absorptive capacity proved to be inadequate to the application of simple labour-intensive technologies. Finally, such technologies which were proposed to curb unemployment had to be introduced without being tested. The risk of receiving know-how which finally did not work efficiently was not accepted by the developing countries.

In the discussion on the technology choice and employment generation in developing countries alternatives were raised to the proposal of an appropriate technology. It was felt that differentiated technology profiles should be prepared considering the targets, the resource endowment, the strategies of development, the absorptive capacity and the international economic framework. As a result a survey of the technology demand of every developing country had to be produced. For analytical purposes, it is helpful to define groups of countries being characterized by almost similar technology requirements. A rough analysis might lead to the following proposal :

—There is a demand for modern and labour-intensive technologies in countries with a large capital supply, a considerable level of industrialization, raw materials available, hugh absorptive capacity of a local and national markets for consumer goods and industry goods. The countries pursue a policy which enhances the modernization of economy and society through integration into the international ecocomic relations. High-level technologies are demanded which enable the national industry to repel imports and to enter into new markets in the developed countries.

—Modern technologies, which are job-creating, are also called for by newly industralized countries which lack of raw materials and which pursue a strong export-promotion policy. Know-how has to enable local producers to increase competitiveness.

—Just a different technology choice is typical for the least developed countries which are characterized by a low level of savings and industrialization, small local markets and which perform a policy to develop economy and society from below. Also, there are practically raw materials not available, which either can be exported or processed to offer job opportunities. These countries ask for technologies which develop the rural sector and the national small and medium-scale industry and which improve the productivity of the agricultural production.

Such a profile seems to cast more light on the employment generation through technology choice which fits to the development and economic policy. Also, technology options are appropriate to the framework and the international relations. Labour-intensive technologies—defined in this more complex manner—

countries took a long time to understand how to provide and disseminate such procedures; developing countries were reluctant and did not correctly assess the demand for labour-intensive technologies. Since pilot projects—due to other reasons—did not initiate further activities to generate employment facilities it is not surprising to understand that technical assistance was not perceived as an instrument to transfer such know-how.

If developing countries learn to draw attention to the necessity of job creating technologies, developed countries' strategy to support the latter's research and development efforts is a most promising way to enlarge the stock of labour-intensive technologies and to improve the conditions for their application. Also, efforts should be made to define and initiate technical assistance projects which transfer labour-intensive

The purchaser lacks of know-how to get a complex survey of available technologies; a—not yet proven—restricted competition among suppliers does not enable the buyer to compare technologies respective to their employment generation. Finally one often cited argument by developing countries' respectives is that labour-intensive technologies are outdated and inferior and would record the technological gap which is one of the most crucial problems of underdevelopment.

Business community in developed countries reasons from the opposite point of view. It admits, however, that the market for labour-intensive technologies is small and does not safeguard an appropriate return on investment in the latter's research and development. But if the demand would be expanded, conditions were fulfilled to spend on innovation along

safeguard a direct and more effective approach to job creation in developing countries.

Potential of technology suppliers

Labour-intensive technologies can be developed by local research and development as well as by a transfer from developed countries. Since scientific capacities in developing countries often are understaffed and have not funds appropriate to undertake research and development, main part of technological and scientific invention is produced in developed countries. Also, researchers and other experts in the developing countries are accused to concentrate their efforts not on the technological demand of the local receivers but to compete with institutions in developed countries

companies. It owns special know-how which dominates in the markets for manufactures. The access to this technology is restricted and can be submitted only by the owner and not by other agencies or institutions. The private transfer of technology is perceived by owners because of their intention to yield returns not directly as an instrument of development policy but as a measure to expand sales or to protect markets against competitors. Private cooperation rests therefore not only on the demand of technology by developing countries but also on the willingness of the owner to submit his know-how on commercial and profitable terms which have to be negotiated. The conditions cannot be—as developing countries often propose—defined by governmental rules or international agencies under the auspices of the United

these lines, and job-generating technologies would be available. The lack of demand is explained by the receivers' attitude. It is the developing countries' own decision that they purchase most modern and capital-intensive technology and not that know-how which is more appropriate to these countries. Finally, private business in developing countries often is forced to apply capital-intensive technologies since the relative prices for productive factors labour and capital are distorted by minimum wage rates irrespective of productivity and by subsidies to interest rates. A complete shift in this policy which is advantageous at any case to the overall development in the long run would also create suitable conditions for a more intensive application of unemployment-curbing technologies.

Theoretical arguments lead to the conclusion, that many of the developing countries' propositions are not substantiated. Moreover, as it is widely held, the developing countries' purchasing policy decides on the share of labour-intensive technology in the transfer of technology. However, it should not be left out of consideration that some studies demonstrate examples of technical rigidities in the suppliers' behaviour. It is not yet quite clear whether these case studies can be generalized or not. It would be—at any case—misleading to suggest that the suppliers' monopolistic behaviour prevents recipients from a total insight in all technology options. The strong competition between producers requests them, to expand sales by offering a complete insight into technical and commercial terms of reference.

Observations from German manufacturers and their transfer of technology to developing countries led to results which confirm this position.[3] An enquiry—conducted 1980/1981—reveals that the demand concentrated on capital-intensive technologies. Slight adaptations have been offered on request. Labour-intensive technologies were not applied, since the latter's productivity was inadequate because of lack of training and motivation. Also, purchasers refused to accept technologies which had not been proven to be effective during use in developed countries.

Low level of demand for labour-intensive technologies did not yield sufficient returns on research and development on job-creating procedures. Public administered prices did not take account of costs for innovation and dissemination of such know-how.

As other studies indicate it has to be assumed that labour-intensive technologies might be transferred more eagerly by small-and medium-sized firms. Their productive structure is more flexible, and the output has to be adapted to the recipients' request since the bargaining power of the supplier is weak. The production organization can be shifted more easily and without huge expenditure. However, it should not be left out of consideration that the impact of this transfer of technology is restricted since private cooperation with enterprise in developing countries rests mainly on big companies and transnational corporations. Small-and medium-scale enterprise because of lack of capital, of personnel and management experience in developing countries' cannot enter into the developing countries' market which are characterized often by political, economic and other risks. Also, their position in negotiations with the administration on import licences is restricted which means more problems for the co-operation.

The demand of labour-intensive technology can be met by a more intensive cooperation with small-and medium-scale industries from developed countries. This, however, requests that the recipients' countries abstain from interventions into exchange of goods, technology, licences and capital. Also, it might be helpful to create favourable conditions for private business cooperation and to remove any short term, not calculable interventions and interferences. This is—admitted by—not an easy job for developing countries which—however—in the long run will be beneficial not only to create job opportunities.

Flanking measures required

Summarising it has to be stated that—although the problem of unemployment is given high priority—

3. cf. K.W. Menck in cooperation with R.E. Schwarz, Technologietransfer in Entwicklungs lander. Der Beitrag deutscher Unternehmen (Transfer of technology to developing countries. Contribution of German enterprises), Hamburg 1981.

labour-intensive technologies have not been transferred yet as it is required. Improvements to develop and to disseminate such technologies include research and development in the developing countries as well as measures to initiate small-and medium-scale industries from developed countries to contribute to the interchange and availability of techniques which generate employment facilities. However, it has to be observed that technology choice is only and not the predominant measure to provide job opportunities. Further instruments should be part of the development policy and development cooperation as population control, liberation of trade and capital movement, training of labour force and structural adjustment and promotion of scientific and technological research and development. This economic policy refers on the one hand to the economic compulsions by the object in question and promises on the other hand in the long run benefits to developed and developing countries not only in job creation. A step-by-step-policy might be helpful, if other—mainly political—barriers have to be removed before starting such a procedure. A political and social climate of consensus on the policy to curb unemployment is another condition for a successful strategy to create more job opportunities in developing countries.

Shri R.S. Gupta, Dy. Director General, National Productivity Conucil.

and near perfect matching of human body movements with that of machine-pace. These contributions have brought dramatic injection of efficiency in the industrial organisations through effective division of work, high degree of standardisation and specialisation, advanced materials handling and specialised production tooling systems. A classical example is the assembly of Ford's T Model automobile on these principles which brought down car's price in 1923 to less than one-third of that of 1909, enabled workers to triple their wages and reduce thier working hours. In fact use of work study principles leads to a socio-economic breakthrough in terms of higher production, reduced sale price, and higher purchasing power which enabled auto workers to buy their own cars. There are many examples of high

operational efficiency and higher productivity achieved through industrial engineering applications even in our own country (refer to NPC Publications in Industrial Engineering Projects).

Some Constraints

Work study will continue to play useful role in improving enterprise level performance. At the same time, it will be necessary for the practitioners to face some of the realities which tended to be ignored in the past. It is now widely recognised that machine controlled human pace makes the jobs monotonous. In other than poorly paid or highly insecure work situations, monotony causes absenteeism and lower output. In industrially advanced countries, it is difficult to have workers for monotonous jobs. Some studies indicate that monotony can cause damage to workers' mental health and can have a mind deadening effect. These has to be a greater appreciation that jobs should be so designed as could be adapted to individual's capacities, which provide reasonable challange and whose execution given him a job satisfaction. If such characteristics have to be built in the jobs, then it is necessary to create a certain amount of variety in the work done, integrate various auxillary and service tasks into the main job so that worker could have a feel of the wholesomeness of a job, and decouple man from the machine process so that the worker does not feel being tied to the machine during the entire working day.

Twin Objective Approach

This, in other words, means giving attention to making jobs better and satisfying for the workers, besides achieving improvements in operational performance. In fact, higher levels of productivity could be better attained by providing challenging and satisfying jobs to the workers. Higher productivity does not mean higher efficiency of one or few of the sub-system-it means optimisation of the total system. Likewise, better jobs demand minimisation of monotony and uninteresting work and making work a process of self-development. Jobs should provide challenge to the capable people to develop their knowledge and personal capacities, they should feel involved and committed. Thus, the work study applications should have this double focus—of attaining overall efficiency of the total system and making jobs satisfying and challenging for the people doing them.

Some Experiments in New Directions

1. *Machine-Paced to Man-Paced System*

The machine paced system is commonly found in line assembly. In this system, the flow of materials and organisation of work as well as the work pace of an individual are completely controlled by the technical system. The advantages of the machine-paced system are efficient utilisation of space, machines and equipment; efficient operations achieved through fine division of work and specialisation; and consequently, high volume of production. The disadvantages of the system are many. It puts severe constraint on the individual in his work, makes him a cog in the wheel and limits his opportunities to grow within the work and acquire a wider role. In this system, production is highly sensitive to disturbances; if work stops at one station, the entire production stops. This system is not capable of meeting changes in production volume or making several models of a product without re-balancing the line; which is expensive and time consuming.

In order to overcome these disadvantages, successful experiments have been made in changing machine paced system to man paced system which is also known as "parallel group system". In this system, a number or individuals in parallel and independent of each other, carry out essentially the same job. This type of parallisation unties the individual from his tight short task cycle, makes the task cycle longer and work content expanded, creates possibility of working in groups and helping each other within the group, takes care of work disturbances, evens out peaks and valleys of work flows and strives for a common cause of satisfactory work result. However, such a system requires more complex and expensive materials handling system as well as higher inventory costs.

Figure 1 gives the schematic diagram of line assembly or machine-paced system as well as parallel group or man-paced system.

To be precise, man-paced or parallel group system

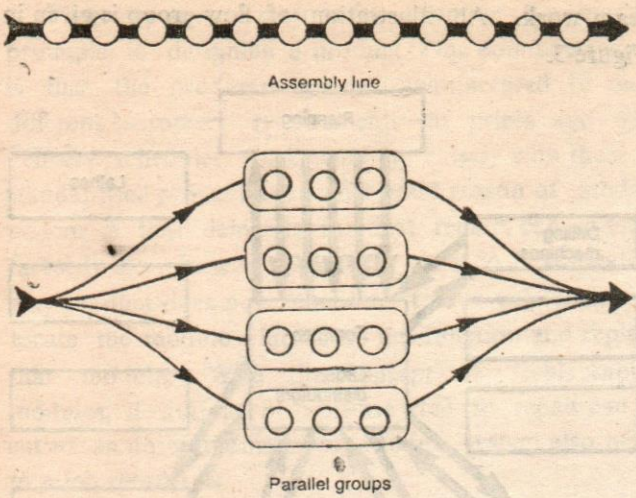

Fig. 1 Schematic diagram of an assembly line and parallel groups

will have lower production losses due to disturbances or down-time, better balancing and use of time, less need for personnel replacement on account of rest periods or limited absence, lower costs for checking and adjustments, faster changeovers for change in production volume or models, etc. However, this system entails complex and costly material handling system, higher tooling cost, increased cost in material supply and more space. In the overall analysis, man-paced system or parallel group system is claimed to be more effective from economic as well as from human considerations.

2. *From Functional Organisation to Product Shop Concept*

Functional organisation is commonly seen in a batch production set-up. Here similar machines or operations are grouped together. The principle of the product shop is just the opposite. It is designed and equipped in order that it can, independently, from raw materials and semi-fabricated material, do every thing required to manufacture a finished product family. The primary objective of the product shop is to unify, physically and administratively, all operations required to produce a product or a family of products. It requires division of a large system of functionally related departments into smaller product based units, which function, to the extent possible, indendently of each other. It means a small company functioning within a large company. The most important principle involved in the product shop concept is that it facilitates decentralisation of the organisation and decision-making; it makes possible to integrate employee participation and co-decision making; it promotes group work and helps individual employees to see the importance of his job in relation to the final product. The other advantages from the point of view of industrial engineering are simplified planning, shorthand through out times, less tie-up of capital in in-process inventories, reduced transport, etc. Some of the disadvantages, however, are requirements of more machines and thus more capital investment in machines, as well as low capacity utilisation of machines.

In designing a product shop, it is necessary that :—

(a) the greatest part of the product chain, from raw materials to finished products, is concentrated within the shop. Provision of complete manufacturing facilities within the shop, with marginal dependence on other units, is a pre-requisite;

(b) division of production into product shop should facilitate decentralisation and, therefore, each shop should have its own resources for administration and services. One of the important advantages of this system is that it is earier to calculate profitability of each product. Large central overheads are not conducive in determining whicn products are doing well and which are not;

(c) the product shop should have more stable production conditions than a conventional plant. Normally, it is not easy to adjust large variations in production volume and product mix or product changes and adaptation to the market conditions in the case of product shop as compared to the functional arrangement. However, it has the advantages in the adaptability to change production volume and product mix.

A schematic diagram of functional and product shop is given in Figure 2.

3. *Flow Groups*

An extention of product shop concept or a small company functioning within a large company can also

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Technology Structure and Employment

PROF. KARL HEINRICH OPPENLANDER

Quantitative employment effects of technical progress and structural change in the Federal Republic af Germany are discussed in macroeconomic terms and illustrated on the industry level with two case studies. Qualitative employment effects are then analysed, based on two recent studies, leading to the conclusion that the change in skill requirements, proceeds slowly and gradually and is caused by a combination of factors rather than technological progress alone. Finally, attitudes toward technical change of German workers and trade unions are described, along with government attempts to facilitate adjustment of man to technology or vice versa.

Professor Karl Heinrich Oppenlander is president of the IFO Institute for Economic Research in Munich, W. Germany.

Introduction

The subject is treated in terms of three different aspects.[1] First, the impact of technical and structural change on the change in employment will be shown, taking account of both, macro and microeconomic factors. Secondly, the effect of technical change on the quality of the labor force will be discussed. Here, changes in the occupational structure and skill requirements are of special interest. Finally, the problem of acceptance of technical and structural changes by employees and trade unions will be examined.

Quantitative Change in Employment

The Aggregate Level

Advances in productivity should be seen as a continuous process, stimulated, on the one hand, by the need to maintain or increase competitiveness and, on the other, by the flow of technological innovations. Both will result in process and product innovations causing the release of workers, but also offering the opportunity of re-employing those released. Productivity growth has slowed in the Federal Republic of Germany; it will, however, continue to exert great influence on economic growth in the future.

1. Cf. Oppenlander 1983

This and the fact that, for demographic reasons, the potential German labour force will increase well into the 1980s, will at times lead to sizeable imbalances in the labour market.

This distribution of productivity gains has, in the past generally been in favor of real incomes. Nevertheless, there was still sufficient scope for a continuous shortening of working hours. It can be assumed that this structure of distribution will remain the same in the future. The number of persons employed is, therefore, greatly affected by gains in productivity and the continuous shortening of working hours.

This is one observation. The other is based on the realization that the absorptive capacity of the service sector is limited in an economy highly geared to exports. In the past, there have been structural employment shifts towards the service sector, corresponding to the structural shifts of demand and production. Nevertheless, because of the sustained high increase of capital employed, the secondary sector releases more workers than the tertiary sector is capable of absorbing. As a result, the secondary sector continues to provide a major proportion of GNP, while its share in employment is continuously declining in favor of the tertiary sector.

Case Studies

In order to illustrate technical and structural causes two case studies will be cited which deal with employment changes due to technical change. Extrapolations to the macroeconomic level are inadmissible, since the structure of the firms and industries studied cannot be regarded as economically representative.

The Institure for Labor Market and Occupational Research[2] used systematic surveys of major manufacuring industries to assess the impact of technical change in the 1970s on the change in employment.[3] The questions concerned new recruitment, transfers into the changing activity, transfers out of the changing activity into other company activities, labor losses, and imputed labor savings, all of these as the result of technical change.

The following picture emerged for the plastics processing, wood-processing, and metal-working industries :

- 2.2% of their labor force were newly recruited, while 0.8% left the companies. More employees were, therefore, recruited from outside than from within the organizations.
- Transfers into the changing activities accounted for only 0.6% the labor force, while transfers out accounted for 1.6%.
- Finally, there was an imputed labor saving through greater productivity of no less than 3.7%.

It is noteworthy that companies with high productivity gains showed particularly high recruitment rates and no more labor losses than other firms.

The seco nd study was carried out by the Ifo-Institute for Economic Rese arch[4] and deals with the effect of the application of micr oprocessors on the release and re-employment of labor.

The microprocessor is frequently labelled a job-killer, because its application in the manufacture of computers, watches, etc. has led to spectacular dismissals of labour. However, according to this study, employment effects of microelectronics depend very much on the area of application.

We must distinguish applications in which electronics are incorporated into products whose main function is to measure, control regulate, and calculate (adoption of the product's principal function). Computers, clocks, watches, teleprinters, taximaters, cash registers, etc. are examples of such products. These applications must be distinguished from those where the measuring, control and calculating, functions are subordinate to the product's principal functions (adoption of secondary functions). Typical examples of such products are television sets with telegame

2. Institut for Arbeitsmarktund Berufsforschung
3. Dostal, Lahner, Ulrich, 1977
4. Cf. Gersten berger, Scholz, Uhlmann, 1978

attachments, cars with electronic fuel injection, computer controlled machine tools, and industrial robots.

Depending on the type of application, the effects of using microelectronics can vary greatly. A strong reduction in employment can generally be expected if the principal function of the manufactured product is taken over by electronics. One reason for this is that mechanical and electromechanical components require a labour-intensive production technology. In addition the performance of automatic measuring, control and calculating functions by electronic devices, as in the case of the watch and clock industry, will lead to a significant reduction in the number of production stages. Because of the low labour-intensity of component manufacture, the resulting release of labour is not compensated by an increase in employment by the component manufacturer. The release effects of a reduction of production stages are so great in these applications that they cannot be offset even by a considerable increase in demand for these products. Increased demand (for pocket calculators, for instance) is, as a rule, caused by price reductions due to improvements in production through the use of electronics. A certain degree of compensation for labour savings in the manufacture of hardware can only be achieved, if the product requires a large amount of software. The manufacture of computers provides a good example of this.

Where electronic devices perform secondary functions of a product, their introduction hardly ever leads to dismissals of production workers. On the contrary the incorporation of electronics frequently extends a product's functions (e.g. television sets with telegame attachment) and/or imporves the products quality (e.g. greater exploitation of the energy input in electronically controlled fuel injection). Product improvement can lead to an expansion of sales. Adverse effects on employment can only occur indirectly, if the products are capital goods and the investor can now achieve a higher level of automation.

As far as the release effects of electronics are concerned, it is of decisive importance whether electronic devices are being applied in a cosumer or capital product. In the case of consumer products, employment losses are generally not expected, unless the incorporation of electronic devices reduces the need for repairs or repair time. In the case of capital goods, the main point is whether an electronic device in a machine will permit automation of operations. If this is the case, labor will be released on a larger scale. This interreiationship does certainly not exist of all capital goods containing electronic parts. The telephone with an electronic pushbutton dialling system will by no means replace the operator; a teleprinter will not replace a typist. The effect of the application to point-of sale terminals is more difficult to assess, as these offer at least indirect possibilities of labour saving in book-keeping, warehousing, and purchasing. In the future, there will also certainly be cases in which the introduction of electronics will allow restructuring of the production process which might also involve skipping some present operations. Changes introduced in printing production methods are a typical example of this development.

In summary, regarding the case of microelectronic we can say that replacing the principal function of a product by an electronic device will result in sizeable releases of labour and a considerable increase in labour productivity through a reduction in the number of production stages in the manufacture of the product. There is no compensation for these effects for the manufacture of the components.

The use of electronics can also have positive employment effects, however, if it leads to an extension of the function of the equipment or if price reductions bring new customer groups into the market. (cf. Table).

Employment Effects of Product-Related Technological Changes Introduced through Microelectronics

Type of product	Employment effect by type of product		
Changes in the product through elcctronics	Consumer Product	Capital Product Manufacturer	Capital Product User
Replacement of subordinate function; possibly connected with extension of function and/or quality improvement	neutral to positive	neutral to highly positive	negative
Replacement of principal function; extension of function; quality improvement	highly negative	depending on software to highly negative	negative

Source: Gerstenberger, Scholz, Uhlmann, 1978, p. 2. 41

To sum up: The industry study confirms that technological change will produce a high rate of release which, however, can be offset by corresponding re-emloyment. Technological change, moreover, generally leads to the transfer of workers. The number of workers transferred to other activities within the enterprise exceeded that of the workers transferred into the activity subject to innovation. The second case study, microelectronics, showed that sizeable releases can generally be expected in the event of a technological change affecting the product's principal function. Some degree of compensation for the release of workers can only be attained if the new product requires a large amount of software.

Qualitative Change in the Labour Force

Occupational Structure

There is nothing to indicate that structural and technological change rapidly altered the occupational pattern. Job opportunities are still available for the more traditional occupations. A 1964 census of old and new occupations in the USA showed that 77% of the labour force worked in occupations that had already existed prior to 1850 and that only 20% of the labour force was active in occupations created after 1900.[5] In the Federal Republic of Germany the number of occupations reguiring apprenticeships dropped from 606 in 1971 to 452 in 1978. The number of jobs in new occupations, therefore, probably still plays a subordinate role. It remains a fact that changes take place mainly within the occupations themselves through changes in scope.

Changes in Skill Requirements

There is theoretical disagreement about the direction in which structural and technological change will shift skill requirements. Theories about a lowering of skill requirements, an increase in skill requirements, and polarization are being defended side by side. A large-scale German investigation into the impact of structural and technological change[6] concluded that neither Blauner's theory[7]—that mechanized production requires lower skills than automated production—nor Bright's theory[8]—that mechanized production requires higher skills that automated production—apply. Rather, it must be assumed that technological and structural change will lead to a polarization of job functions and job requirements. Very simple and mostly monotonous jobs are newly created, activities requiring higher skills are retained or newly created, while the proportion of complex activities demanding an intermediate level of skills declines.[9]

Although the discussion is continuing, Bright's deskillization theory can be dismissed with some certainty, because according to it, all labour would previously have had to possess generally higher skills, a point which cannot be proved. On the other hand, the theory of increasing skill requirements is supported by the fact that the number of white-coller jobs has increased, while the proportion of unskilled and semi-skilled workers has steadily declined. There is also a particularly high level of unemployment among unskilled labour. All of this goes to prove that the standards of a highly industrialized economy are still rising.[10]

On the other hand, it is not clear whether new technologies such as micro-processors, produce higher qualification or polarization effects. The former are suggesested by the fact that the introduction of the micro-pocessor will demand qualifications related to software. "The development of usually requires higher skills than the tending or control of machinery. Particularly important factors in the development of software (programming, systems analysis) are creativity and the ability to 'analyse difficult problems".[11] A certain polarization of skills is indicated by the fact that the "assessment of skill requirements can be subject to fluctations. For instance, an operator's job was initially regarded as requiring higher skills than comparable conventional job...Today it is rated...more prosaic".[12]

5. Ulrich and Lahner, 1970
6. See Oppenlander, 1971
7. Blauner, 196 4
8. Bright, 1958
9. RKW, 1970
10. Ulrich, 1980
11. Dostal and Kostner, 1977, p. 249
12. *Ibid.*

It may even be possible to develop a clear-cut theory. Each technological innovation may have a different impact on skill requirements. "Development laws" unduly simplify actual facts. In particular, they do not make allowance for the variety within the whole range of industrial jobs.[13] It is therefore again necesaary to fall back on specific German case studies, which were recently presented by two institutes.[14]

Studies of five industry groups established that (spectacular) technological changes raised the demands on practicals skills, responsibility, and mental stress, but lowered the physical demands and the negative environmental influences, such as noise, heat, cold, poisons, accidents.[15] The introduction of new technologies did not require any change in the education and training standards, however.

A study of the effects of new technologies on the labour market[16] underlines the increasing importance of skills which transcend job-specific qualifications and are additional to them. Individuals are "faced with new demands involving a better grasp of the entire system, greater responsibility, and a different attitude towards decision making."[17] This applies mainly to traditional industrial jobs. Commercial and administrative occupations require more communicative and analytical skills than before. Management staff is a special case in point, as new technologies facilitate simple and routine tasks, but also generate new demands, such as faster decision-making in new situations. The complexity of the decision-making environment is also increasing. Managers now "have to be able to assess the possible positive or negative consequences of a decision for the company and the employees".[18]

The studies agree that the process of change, which is described in relatively dramatic terms, actually proceeded slowly and along conventional lines. Structural change, like economic growth, had slowed down and this was reflected in the slow changes in job requirements. Moreover, the studies found no close correlation between changes in job requirements and tangible technological change, but rather suggest that a combination of causal factors would ultimately lead to a gradual alteration of skill requirements. It seems to take a relatively long time before new job contents lead to revisions in educational and training programs; furthermore, it should not be overlooked that educational policy-makers frequently establish an unnecessarily exacting set of requirements.

Against this background one can, nonetheless, discern broad development trends:

—Based on the trend towards higher qualifications. job-specific training should be provided by continuing on-the job training, while skills which transcend job specific qualifications should be taught by the school system as part of general education.[19]

—Based on the fact that narrowly defined activities (with respect to product, process, industry, and performance standard or to a certain form of work organization) are actually in greater jeopardy, general technical and trade skills should be freed from their dependence on a specific industry, product, or process.[20]

Problems of Acceptance of Structural and Technical Chapter

It seems that structural and technological change are creasingly subjected to criticism. People are no longer willing to accept changes readily or to adapt rapidly. "This is due to the characteristic ambivalence increasingly marking the attitude of man towards technology, the ambivalence of expectation and apprehension. Technical innovations, like all innovations, have the disturbing result that a former and known state is suddenly changed, familiar routines and conceptions no longer seem appropriate, and the unintentional consequences of such change come to light only with time. Technical innovations are, therefore, a source of insecurity and of destruction of the familiar. Yet human needs are never met...technical

13. RKW, 1970, p. 318
14. Ulrich, 1980, Blum, 1980
15. Dostal, Lahner, Ulrich, 1977, pp. 24 ff; Ulrich 1980
16. Blum, 1980.
17. *Ibid.*, p. 21
18. *Ibid.*, p. 22
19. Blum, 1980, p. 24
20. Ulrich, 1980

inventions have been and will also in the future be the decisive means of meeting such needs. High hopes and expectations are, therefore, linked to the development of technology."[21]

A survey of industrial workers confirmed the predominance of this ambivalent attitude. "The majority of workers expect technological change to have positive as well as negative effects, although they remain unsure to which should be attributed greater importance."[22] This survey was used to derive two "lines of reasoning". On the one hand, technological change has been welcomed, not only from a purely physical point of view but also with respect to the general social situation, for having permitted a continuing and substantial reduction of the "manual and physical aspects of industrial work". On the other hand technological unemployment is regarded a great danger, dampening optimistic expectations about technical progress.

To this day, these two lines of reasoning have lost none of their importance. The increase in unemployment in the Federal Republic of Germany since the mid-1970s has again focused attention on the consequences of technical change. Two developments may serve as examples. First, the attitude of West German trade unions towards technical progress has changed. Secondly, the government has been trying to contribute to the "humanization of working life" by means of ever expanding research programs.

In the past, German trade unions had a rather positive attitude towards technological progress, not least in times of full employment. The employment effects of rationalization measures were regarded as inescapable circumstances to which they largely responded with defensive protective measures, aimed primarily at safeguarding the social position of workers through retraining programs, income maintenance, severance pay, etc. The agreements to safeguard employees against the consequences of rationalization, following the automation debate in the Federal Republic of Germany, must be seen in this light. By the end of the 1960s collective bargaining agreements containing protective measures against social hardship as a result of automation and rationalization covered a large part of West German wage and salary earners. These agreements were supplemented and standardized on a federal scale, wherever possible. In most cases they also became part of the collective bargaining agreements for the respective branch or the respective bargaining area. This implied, on the one hand, legal sanctioning, but on the other, also allowed for the possibility of raising again the issue of rationalization-safeguard agreements contained in a collective bargaining agreement, whenever it expired or was cancelled.

Since 1978 the attitude of trade unions towards technical progress has changed. They are now pursuing a policy of selectively influencing the time, course, and consequences of the mechanization process. The main features of the new strategy are: the extension of protection against dismissal; a further shortening of working hours; control and limitation of performance intensity; the safeguarding raising of the skill level, as well as protection against the downgrading of jobs.

The federal government's action program for the "humanization of working life" has the following goals: Development of safety data, target values, minimum standards for equipment, plant, and work places; development of working techniques appropriate to man; Compilation of suggestions and models for the organization of work and work places.

Without doubt, these are attempts to facilitate the adjustment of man to technology, perhaps even to ensure that technological and structural changes adapt to man and not vice versa. However, as long as technical progress, structural change, and economic growth must be considered a contest with nature and success is measured by the increase in the standard of living, the ambivalence between expectation and apprehension will remain. Problems of acceptance should be met, however, by solutions which tailor work to man.

21. Lepsius, 1971, p, 29 f.
22. RKW, 1970, p. 344; cf. also Kern and Schumann, 1970

REFERENCES

Blauner, R. (1964) *Alienation and Freedom*, Chicago and London.

Blum, A. (1980) "Neue Technologies und Arbeitsmarkt" in: *Beschaftigungspolitik fur die achtziger Jahre*, Sozialwissenschaftliche Reihe des Battelle Instituts, Munchen, pp. 11-24.

Bright, J.R. (1958) *Automation and Management*, Boston

Dostal, W., and Kostner, K. (1977) "Microprozessorn—Auswirkungen auf Arbeitskrafte ?" in: *Mitteilungen aus der Arbeitsmarkt—und Berufsforschug*, Vol. 10, No. 2.

Dostal, W., Lahner, M., Ulrich, E. (1977) *Datensammlung zum Projekt Auswirkungen technischer Anderungen auf Arbeitskrafte*, Institut fur Arbeitsmarkt—und Berufsforschung, Nurnberg.

Gerstenberger, W., Scholz, L., Uhlmann, L. (1978) *Auswirkungen des technologischen Wandels auf die Wirtschaftspolitik*, Ifo-Institut fur Wirtschafts-forschung, Munchen.

Kern, H. and Schumann, M. (1970) *Industriearbeit und Arbeiterbewubtsein*, Frankfurt (Main)

Lepsius, M.R. (1971) "Soziale Konsequenzen von technischen Fortschritten" in : *Wirtschaftliche und gesellschaftliche Answirkungen des technisnhen Fortschritts*, Dusseldorf.

Oppenlander, K.H. (1971) "Wirtschaftlicher und sozialer Wandel durch technischen Fortschritt—Uberblick und Ausblick" in : *Beihefte der Konjunkturpolitik*, No. 18.

Oppenlander, K.H. (1983) "The Impact of Technical and Structural Change on the Structure and Employment of Manpower" in : *P. Streeten and H. Maier (ed.), Human Resources, Employment and Development*, The MacMillan Press Ltd', London.

RKW (Rationalisierungs-Kuratorium der Deutschen Wirtschaft) (1970) *Wirtschaftliche und soziale Aspekte des technischen Wacdels in der Bundesrepublik Deutschland*, Vol. 1: *Sieben Berichte*, Frankfurt (Main).

Ulrich, E. and Lahner, M. (1970) "Zur Prognose neuer Berufe" in : *Mitteilungen aus der Arbeitsmarkt—und Berufsforschung*, Vol. 3, No. 1.

Ulrich, E. (1980) "Technischer Wandel und seine Auswirkungen auf Arbeitsbedingungen and Qualifikationsanforderungen" in : *Technologie und Arbeitsmarkt*, (Symposium of October 3, 1979 in Stuttgart), Stuttgart, pp. 44-64.

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Technology Development for Commercial Industry

SHEKHAR CHAUDHURI

This paper presents a conceptual model of technological innovation based on an indepth study of the process of technology development in a national laboratory and its successful commercialization through a Public Sector enterprise.

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Introduction

Research and development in India had been a virtual monopoly of the Central Government till the beginning of the sixties. The composition of national R & D expenditure shifted radically during the sixties; nevertheless even in the beginning of the seventies the CSIR laboratories accounted for about 40 per cent of the same. However, the results of this effort have not been too encouraging.

It is in this context that the study of cases of successful transfer of technology from national laboratories to business enterprises becomes extremely relevant. This paper presents a model of the innovation process based on the author's case study of the process of development and commercialization of the Swaraj tractor and studies done by Bhatt and Aurora and Morehouse. In this article I have taken the viewpoint of the top management of the Central Mechanical Engineering Research Institute (CMERI) and Punjab Tractors Limited (PTL) and have analysed the situations to draw some implications meaningful for the management of technological innovations in India.

Summary of Case

CMERI was established in 1958 at Durgapur in West Bengal. Its objectives were :

1. Development of substitutes for imported raw materials.

2. Indigenous manufacture of essential components hitherto imported.
3. Development of indigenous knowhow at a significantly advanced level to be commercially utilizable in respect of those articles on which repeated foreign collaboration has been sougtht.
4. Measures through which the programmes of industrial research could be oriented to the needs and requirements of industry.

In consonance with the above, the CMERI engaged itself in developing indigenously an agricultural tractor which was to become later one of its most prestigious projects.

The driving force for the innovation was the pride of certain key individuals in Indian engineering skills and they played a critical role in pushing the project from the design stage to its ultimate commercialization. The product chosen for development was a 25 h.p. tractor. The design was to be centred around the technological capabilities and production capacities already existing in the country to prove that Indian technological capability had come of age. The philosophy behind the design was that the tractor should be comparable with the top-ranking makes available in the country in terms of performance characteristics and price.

The engine used was already being manufactured in the country by a diesel engine manufacturer with foreign collaboration. But it had to be modified for its use on the tractor. A new design concept in the hydraulic system was evolved to avoid patient infringement. This design was later awarded international patents and a system was designed to match the engine. The final product which was the result of matching various assemblies was a blend of various design philosophies and hence could not match equivalent makes in terms of design sophistication, nor could it be manufactured at a very low cost like the Eicher tractor. At the time PTL entered the tractor industry, Eicher and Hindustan Machine Tools (HMT) were already available in the market.

Though the industrial licence was for a capacity of 10,000 tractors, PTL was constrained to follow a policy of incremental capacity expansion in two stages of 5,000 tractors per annum, in view of the pressure from the financing agencies to reduce project cost.

The project was promoted by the Punjab State Industrial Development Corporation Limited (PSIDCL) and so it had necessarily to be located in Punjab. There were certain financial incentives available in locating the plant in Mohali, a backward area in the state. Proximity to the large tractor market in the North and the traditional entrepreneurial qualities of Punjabis were both important factors which were considered. The Swaraj tractor was designed and developed in a research laboratory. It had to be tranformed into a production model. The engineering and the managerial skills required for manning the manufacturing system and to be acquired. The company opted for hiring a consultant for engineering the manufacturing system and training the core team of design engineers, who had transferred from CMERI. The alternative was chosen to reduce revenue expenditure. The manufacturing system had to be designed to match the product-market-technology posture, within the constraints of limited funds and to have the flexibility to manufacture other models as and when they were developed. The manufacturing technology chosen was a combination of batch and mass production technology with a bias towards use of a large number of general purpose machines in order to reduce capital investment. Even the very expensive special purpose machines were used like general purpose ones for achieving high rates of capacity utilization. However, to reduce capital costs the company manufactured jigs and fixtures within the plant for which the tool room block was constructed first. To reduce capital costs a very large percentage of the components were planned to be procured from vendors.

During the implementation of the project, because of inflation, the project cost continued to rise. To counteract this, building designs were changed and innovations in construction technology were made at the initiative of the Managing Director and the project was completed within the estimated cost and time schedule (see Tables 1 and 2). Inspite of the many innovative ideas, the cost of production could not be lowered to compete with the Eicher tractor. The

Table 1

Swaraj Tractors : Project Cost

(Rs. millions)

Details	Expected (March '72)	Actual (April '74)
Land	1.162	0.985
Buildings	2.252	3.345
Plant and machinery		
(a) Imported	3.191	3.135
(b) Indigenous	15.426	13.457
Technical Know-how	2.073	1.640
Miscellaneous assets	0.781	2.337
Preliminary expenses	0.480	0.583
Pre-operative expenses	5.050	5.187
Provision for contingencies	2.300	—
Margin for working capital	4.287	5.157
	37.002	35.916

Source : V.V. Bhatt, "Decision Making in the Public Sector : Case Study of Swaraj Tractor," Economic and Political Weekly, 13 (21) (May, 1978).

Table 2

Some Performance Indicators

	Expected	Actual
Capital Cost (Rs. million)	37.002	35.916
Gestation lag (weeks)	105	105
	(March 1972 to March '74)	(March 1972 to March '74)
Output/Sales of tractors (numbers)		
1974-75	1,600	933
1975-76	3,500	2,242
1976-77	4,500	3,196
1977-78	5,000	4,003
Operating profit (Rs. million)		
1974-75	—3.656	—8.82
1975-76	—0.320	+0.57
1976-77	1.761	+11.89
1977-78	2.702	+13.34

**Source* : Company documents.

machines which PTL had purchased were several times more expensive than those purchased by Eicher. PTL's machines were the latest, perhaps costliest; whereas Eicher's machines were extremely simple and cheap. PTL tried to achieve higher volumes and lower costs by working three shifts which was an exception among the major tractor manufacturing firms at the time.

These policies created a tremendous strain on the organization. The management of PTL diagnosed the cause of the problem as the lack of a clearly identified product-market-technology strategy. They took action to remedy the situation by broadening the product range by adding a higher horsepower tractor within 18 months of comencement of commercial operations. Within a short time they shifted their emphasis from the 25 h.p. tractor to the 35 h.p. tractor. This again helped to achieve the phenomenal result shown in Table 2.

A model of the Innovation Process

The model of technological innovation presented here conceptualizes it as a five-stage-process. These stages may be differentiated across a few key dimensions or characteristics. The perspective taken is that of the top management of the research organisation (CMERI, in this case) and the manufacturing enterprise (PTL, here) which utilizes the technology developed by the former. The five stages in the innovation process are described in tabular form in Table 3. The action initiator or coordinator is the research organization during the first three stages and then our focus shifts to the manufacturing enterprise during the last two. The nature of top management task undergone change as the innovation process progresses. The number of external constituencies and their type, the decision areas involved, and the problems faced very across these five stages. The criticality of the tasks determines the focus of attention of the top management. The other characteristics that differentiate the sub-processes are the relative duration of the subprocesses; the degree of overlap, which determines whether the processes need to be managed simultaneously; and the autonomy of the enterprise.

Table 3

Stages in the Innovation Process

	Stage I Opportunity identification	Stage II Technology development	Stage III Project formulation and technology transfer	Stage IV Technology utilization	Stage V Technology updating
Action initiator and/or coordinator	Research organization	Research organization	Research organization	Manufacturing enterprise	Manufacturing enterprise
Characteristics External constituencies dealt with	1. Governmental Agencies 2. Ad hoc groups created by government	1. Governmental agencies 2. Technical advisors 3. Potential clients either in private or public sector	1. Larger number of governmental agencies 2. Technical advisors 3. Potential clients 4. Consultancy firms 5. Financing agencies 6. Representatives of political parties	1. Governmental agencies 2. Promoter 3. Research organization 4. Financing agencies 5. Potential component suppliers and dealers	1. Research organizations 2. Suppliers, dealers, and users
Top management tasks	1. Identify environmental opportunity 2. Obtain government support 3. Identify client and obtain its support	1. Identify new client and secure its support 2. Acquire resources and develop capabilities 3. Define the problem in greater detail 4. Create an organizational context for pursuing work 5. Develop confidence and motivation in the team	1. Identify and secure support of new clients 2. Compaign for indigenous technology to obtain support of external evaluators 3. Negotiate terms and conditions 4. Sustain motivation of the design team	1. Acquire resources and develop capabilities 2. Build credibility with component suppliers/product distributors 3. Create appropriate organizational context 4. Give direction for solving technical problems 5. Redefine the firm's strategy	1. Identify new market needs 2. Create proper organizational context 3. Achieve internal coordination and optimal resource allocation

Table 3 (*Contd.*)

1	2	3	4	5	6
Problems faced	1. Hostile Environment 2. Lack of external credibility	1. Uncertainty of client support 2. Technical problems 3. Hostile environment	1. Uncertainty of client support 2. Lack of governmental support 3. Lack of external credibility 4. Excessive dependence on external environment 5. Lack of appropriate links with external constituencies	1. Hostile environment 2. Mismatch between customer need 3. Cost increases due to environmental changes 4. Resource constraints 5. Lack of appropriate linkage with market	1. Resource constraints 2. Narrow perspective as a result of specialization
Top management focus	External Environment	Internal management	External environment	Internal management	Internal management
Relative duration of subprocess	Short	Long	Long	Long	Long
Degree of overlap	Low or negligible with stage II	Low with stage I, high with Stage III	High with Stage II, long with Stage IV	Low with Stage III, high with Stage V	High with Stage IV
Degree of autonomy	Low	Medium	Low	Medium	High

Exibit 1

Comparison of Product Parameters

Make Dimensions	Eicher	PTL	HMT
Horsepower	26.5	24	25
Design Sophistication	Low	Medium	High
Price	lowest	near highest	highest

Stage 1 : Opportunity Identification

A research organization in its formative stage faces considerable problems in obtaining support from its external constituencies. These problems are exacerbated by a hostile environment and lack of external credibility. Transition from this stage to the next may be aided by dogged determination and persuasive skills of the top leadership. When Mr. M.M. Suri, the leader of CMERI, thought of the 25 horsepower tractor project, CMERI had yet to gain external credibility. However, he was able to obtain the support of the government because of his personal charisma, persuasive skill and his network of relationships in Government.

At the time CMERI took up this project, its existing technical, managerial, and financial resources and capabilities were not sufficient for the task. Compound-

ing the problems faced during the later stages of the innovation was the strong xenophilic attitude of the public at large and especially the government's administrative machinery. By taking up a project, which did not match its resources and capabilities, the CMERI externalised its locus of control. This resulted in considerable strain on the organization members and delay and uncertainty as to the future of the project at every stage.

Stage II : Technology Development

During this stage, top management has to guide the design team in the performance of the various tasks like definition of the technological problem, acquisition of appropriate resources, development of technical capabilities, creating an appropriate organizational context, and the development of a high degree of confidence. Though the top management focus is on the internal management, it might be called upon to deal with external constituencies to sustain their support. The tasks described above are specifically related to Stage II. However, there is a considerable degree of overlap between Stage II and Stage III which implies that during a certain period the tasks of Stage II and Stage III have to be accomplished simultaneously. This characteristic increases the complexity of the top management task.

In the case of CMERI, though the Planning Commission supported the Swaraj tractor, the Ministry of Industry which represented another part of the government went to Czechoslovakia and signed an agreement with M/S. Motokov for setting up a plant in the public sector with their collaboration. However, this sudden loss of support did not create immediate problems as the client, a private sector enterprise, continued to support it; but financial problems later forced the client to withdraw. This created some uncertainty for CMERI till Mr. Suri was able to identify and obtain support from another client, this time a public sector enterprise the Mining and Allied Machinery Corporation (MAMC).

The strong value orientation of the team towards indigenous technology helped it tide over long periods of frustration, and its confidence increased as it learnt through its mistakes. Although the inculcation of appropriate value seemed necessary during this stage to forge individual organizational members into a strong team and to bring out the best in them, it can lead to an inappropriate definition of the technological problem as the following example illustrates. The design of the tractor produced by CMERI was guided by the design team's pride in indigenous engineering skills. The design team wanted their product to be comparable with top-ranking models available in the country. However, since the final product was a blend of various design philosophies, it could not sharply match the needs of any particular market segment.

Stage III : Project Formulation and Tcehnology Transfer

Management of external relations is extremely important and complex during this stage. The top management has to deal with consultancy firms, financing agencies, external technical evaluators appointed by government and representatives of political parties, in addition to those it deals with during the proceeding stages. Problems during this stage might result from contradictory responses from different departments of the government, thus creating ambiguity, uncertainty, and sudden withdrawal of support by client or the government. These problems may be compounded by a lack of external credibility and institutionalized linkages with external constituencies; and excessive dependence of the research organization on the constituencies. However, these may be overcome by the dogged determination and persuasive skill of the project champion as described in the case. Sustained motivation of the project team is essential for transition to Stage IV. During this stage a critical process of the transformation of the project team from its predominantly technological bias to a business orientation is initiated. This is made possible because of the exposure of the design team to external constituencies, which evaluate the technology predominantly from an economic point of view. Though this process is absolutely essential for ultimate success of the innovation, it might be risky to expose the research organisation to external evaluation too early. External evaluation during this stage becomes inescapable as top management has to obtain the support from financing agencies and the government. This process may create considerable

strain. However, this may be alleviated if there exists a supportive but evaluative external constituency. Though the Planning Commission supported the Swaraj project initially because of a change in its membership composition, there was a loss of impetus. Another blow was the sudden resignation of Mr. Suri, the initiator of the project. However, the leadership vacuum was ably filled by the project team leader Mr. Chandra Mohan.

Also Mr. Suri himself continued to crusade and mobilize support for the Swaraj tractor project and was actually involved in its implementation later through his consultancy firm M/S. M.M. Shri & Associates during the initial period. In a sense, Mr. Suri could be described as a project champion. One set of external evaluators, HMT, a potential client and the National Industrial Development Corporation (NIDC), the agency appointed by the Government went against Swaraj, whereas the other potential client, the PSIDCL was initially hesitant. The major financing agency, the Industrial Development Bank of India, also initially hesitant, raised some very strategic issues as a result of which the project team made a number of changes in the product design and project plan. The exposure of the project team to questioning by the promoter and the financing agency over a considerable period of time initiated the process of transformation of the design team's technological bias to a business orientation. The consultancy firm of Mr. Suri played a supportive role in this process.

Stage IV : Technology Utilization

As the innovation process progresses to Stage IV there is a shift in our focus from the research organization to the manufacturing enterprise as the latter takes up the role of the action initiator. Initially PTL found it difficult to convince potential component suppliers to take up the manufacture of Swaraj components. It seems that ancillary industry was not convinced that the Swaraj tractor, based on indigenous technology would be acceptable in the market. The PTL team was determined to prove themselves and hence started manufacturing as many components as possible, a step essential to build credibility with the potential component suppliers. On account of this the production volume could not pick up as planned but it served as a major selling point for PTL. On the marketing front also PTL faced similar problems, which was overcome by concentrating all efforts in a small area and gradually increasing the reach. PTL also experimented with a variety of incentives attract dealers. The critical top management tasks are related to internal management : acquisition of resources and development of capabilities, creating appropriate organizational context for the tasks, giving direction for solving technical problems and possibly, redefinition of the firm's overall strategy.

Problems during this stage may be the result of an imbalance between a predominantly ideological orientation in the definition of the technological problem and the economic realities of the market. The process of balancing ideology with economic aspects started during stage III, however, there still remained areas with a technological bias. These surfaced during this stage in the form of a mismatch between the first tractor model, Swaraj-724 and its intended market segment, the small farmer; and need for purchasing additional machinery, when some of the assumptions made during the planning stage were found to be wrong. The problems in this case were enhanced because of hostility towards indigenous technology, change in the market from a sellers' to a buyers' one, and inflationary conditions in the economy.

The problems created by the imbalance between technological and business orientations may be overcome by a highly determined and motivated team as in this case. PTL's team used a number of unconventional technologies in their construction work to achieve economies: for instance, it created a separate department attached to the managing director for ancillary development, and a product servicing department within the R & D department to respond rapidly to field problems. A critical factor that helped the PTL management was the fact that they knew the intricate details of the project, they were absolutely determined to prove themselves, and they had the decision-making power as a close-knit team to make the necessary adaptations.

Stage V : Technology Updating

In an organization, where technology is its chief resource and which is developed by the dominant group within it, activities related to product adaptations, quality assurance, and value analysis are likely to be emphasized right from the beginning and hence the stages of technology utilization and updating are required to be managed simultaneously as the case was with PTL. The internal management problems are related to allocation of scarce resources to competing activities and ensuring their optimal use and that of strengthening and sustaining organizational mechanisms for obtaining market feedback and incorporating them in relevant decisions. During this stage top management attention is focused inwards. The top management task in relation to the external environment is related to identification of environmental changes and choosing areas to direct technology updating activities. This stage is characterized by an increase in enterprise autonomy.

Implications for Management

The model of technological innovation described in this article points to some observations which may be useful to decision-makers involved in such processes. The implications drawn here are very tentative, since the conceptual model is developed on the basis of one case study.

1. The five-stage model presented here points to the fact that a uniform style of management would not be appropriate throuhgout the total innovation process. The *critical tasks of top management vary as the innovation process progresses from Stage I through Stage V.*
2. During Stage I the critical task of top management is to choose opportunities that match the research organization's resources and capabilities. *A highly determined leader capable of influencing the external environment and generating commitment of organizational members through non-economic goals can help in the successful management of this stage.*
3. In stage II internal managerial tasks assume great importance. *The top management should try to develop a sense of prestige and confidence based on ideological issues which helps in the development of a close-knit design team which can withstand the frustrating experiences of technology* development. However, a *balance between ideology* and *business orientation is crucial for the success of the innovation. This calls for an exposure to (supportive) external evaluation.* The exposure, however, should not be premature, for it could adversely affect building of a sense of confidence which is essential.
4. External relations during Stage III are most complex. Top management is required to sell indigenous technology aggressively to the concerned external constituencies. *A high degree of understanding of the details of the project, and ability to persuade and negotiate are key requirements of the top management.*
5. During Stage IV and V internal management assumes greater importance than external relations and *top management is required to help in the building up of the organization and re-examination and redefinition of the strategy of the manufacturing enterprise.*
6. The *nature of relationship between the sub-processes implies that an organic linkage between them would be useful in overcoming the problems.* The characteristics of leadership during the five stages, given the differing nature of tasks, would also be different.

REFERENCES

1. Aurora G.S. and Morehouse Ward, "The Dilemma of Technological choice in India: The case of the Small Tractor" *Minerva*, Vol. XII, No. 4, October 1974.
2. Bhatt V.V., "Decision Making in the Public Sector: Case Study of Swaraj Tractor, "*Economic and Political Weekly*, 13(21) (May, 1978).
3. Chaudhuri Shekhar, *Acquisition and Assimilation of Technology in the Tractor Industry in India: The Stratagic Perspective*, Unpublished doctoral dissertation submitted to I.I.M. Ahmedabad, 1980.
4. Council of Scientific and Industrial Research, *First Get Together of Research and Industry—Addresses and Key Papers*, December 20-21, 1962, New Delhi.
5. Desai Ashok V., "Research and Development in India," Margin Vol. 7, No. 2, January 1975, pp. 52-91.

Productivity
1984 XXV, 1, 35-38

Technology vs. Technique: The Implications for Labour Utilisation

B. N. GHOSH

For the wheat production in Punjab, employment and output per acre can be maximised by adopting bullock farming technique in conjunction with modern biochemical technology. On the contrary, if the biochemical technology is traditional and mechanised farming technique is practised, output and employment in the wheat production would be the lowest. Mechanised farming reduces not only employment but also output per acre. For maximising both output and employment, bullock power technique yields a far better result and, seems to be a more desired technique of cultivation. As expected, modern technology can and does have higher employment and output effects so far as wheat production in Punjab is concerned.

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Introduction

In agricultural production, as in the case of industry, various technologies and techniques are used at different times and stages of economic development. Needless to say, the alternative techniques which have distinctly different connotations, and which will be distinguished later in our study, have varying output and employment implications. The main burden of the present note is to empirically appreciate the employment and output differentials of alternative agrarian technologies and techniques with reference to Punjab agriculture. The note seeks to determine the optimal combination of the existing bio-chemical technology and power technique which can ensure not only maximum output but maximum labour utilisation as well. Such an exercise may be helpful in eradicating, or at least reducing, underemployment both open and disguised.

Data Studied

Our study is confined to only wheat cultivation in Punjab. The data for this study have been collected from a direct survey of four villages of Punjab during 1981 summer. We have considered 160 wheat farms from district Patiala which forms a zone of average development so far as agriculture is concerned in Punjab. We first selected two Tahsils, Patiala and Rajpura from the district Patiala, and then, two villages from each of these Tahsils have been randomly selected. We have selected villages Daun Kalan and

Sheikhpur from Patiala Tahsil and villages Alampur and Kaulo Majra from Rajpura Tahsil. We selected 40 wheat farms from each village and thus 160 wheat holdings formed the basis of our study. The necessary data from the studied villages were collected personally through interviews and contact during April-May of 1981.

Technology vis-a-vis Technique

In order to understand the labour utilisation process in its proper perspective, it is necessary to make a clear distinction between technology and technique. However, no formal distinction is generally made between these two processes nor is any clear-cut definition available which is universally acceptable for conceptualising either technology or technique. But the fact remains that these two concepts do not have similar meanings or implications, and any attempt to define the concepts is likely to invite controversies. For our analysis, we have conceptualised "technology" as the application of knowledge entailing the use of combinations of material inputs of bio-chemical nature, and "technique" as the method of delivery and diffusion of these bio-chemical inputs by means of different media such as human labour power, bullock power or mechanical power. Such a line of approach for distinguishing between technology and technique has also been recognised by William Bartsch.[1]

Thus, whereas technology involves bio-chemical inputs, technique entails the alternative sources of draught power. In our analysis, we will use two types of techniques and of technologies as prevailing in Punjab agriculture. The two power techniques are: Bullock Power technique and Mechanical Power technique, both of which are primarily used for land preparation and ground work. The two prevailing technologies are: Traditional technology and Modern technology. While the former uses traditional seed varieties, meagre fertiliser and little or no irrigation, the latter consists of a package of HYV seeds, larger quantity of chemical fertiliser and considerable irrigation facilities alongwith improved cultural practices.

1. William Bartsch, *Employment and Technology Choice in Asian Agriculture*, ILO, WEP Study, Praeger Publishers, 1977, pp. 4-5.

In fact, agricultural operations can be carried on either by traditional technology or by modern technology, alongwith either bullock power technique or mechanical power technique, as shown in the following chart.

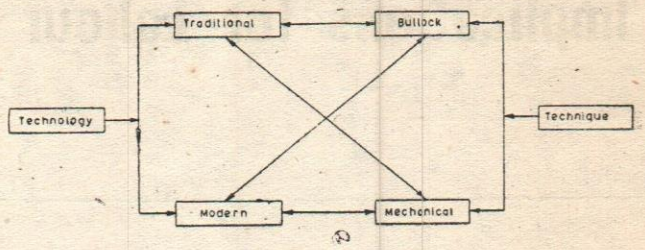

Fig. 1

We have used the following four alternative combinations of technologies and techniques for studying labour utilisation in Punjab agriculture :

$$A = \begin{matrix}\text{Traditional Technology} \\ + \\ \text{Mechanical Technique}\end{matrix}$$

$$B = \begin{matrix}\text{Traditional Technology} \\ + \\ \text{Bullock Technique}\end{matrix}$$

$$C = \begin{matrix}\text{Modern Technology} \\ + \\ \text{Mechanical Technique}\end{matrix}$$

$$D = \begin{matrix}\text{Modern Technology} \\ + \\ \text{Bullock Technique}\end{matrix}$$

Labour Absorption

Labour utilisation in the cases of different techniques and technologies are presented in Table I, II, III and IV. As Table I shows, under bullock power technique, modern technology (HYV) can increase labour utilisation by more than 100 per cent and output by 75 per-cent as compared to the traditional technology.

But under mechanised farming, labour utilisation and output per acre under modern technology increased at lesser rates i.e. by 23 per cent and 57 per cent respectively. This shows that whatever be the technique of cultivation, modern technology can considerably increase both output and labour utilisation per acre. Both wheat output and labour utilisation per acre were the highest on bullock farms using

Table I

Labour Input Per Acre on Bullock Farms (Manhours)

	Traditional Technology	Modern Technology	Index of Modern Farms (Tradional Farms = 100)
Number of Farms	60	40	
Agricultural Operations			
Preparatory Tillage (Ploughing)	48	64	133
Sowing and Transplantation	8	16	200
Application of Fertiliser	64	136	213
Weeding	24	64	267
Irrigation	32	134	325
Harvesting	32	48	150
Crushing and Threshing	32	56	175
All Operations	240	488	203
Output per acre (Quintals)	8	14	175

Table II

Labour Input per Acre on Mechanised/Tractor Farms (Manhours)

	Traditional Technology	Modern Technology	Index of Modern Farms (Traditional Farms = 100)
Number of farms	25	35	
Agricultural Operations			
Preparatory Tillage (Ploughing)	16	40	250
Sowing and Transplantation	56	8	14
Application of Fertiliser	96	88	91
Weeding	56	72	129
Irrigation	10	8	80
Harvesting	24	32	133
Crushing and Threshing	24	40	167
All Operations	232	288	124
Output per Acre (Quintals)	7	11	157

Table III

Labour Input per Acre on Traditional Technology (Manhours)

	Bullock Farms	Mechanised Farms	Index of Mechanised Farms (Bullock Farms = 100)
Number of Farms	60	25	
Agricultural Operations			
Preparatory Tillage Ploughing)	48	16	33
Sowing and Transplantation	8	6	75
Application of Fertiliser	64	96	150
Weeding	24	56	233
Irrigation	32	10	31
Harvesting	32	24	75
Crushing and Threshing	32	24	75
All Operations	240	232	97
Output per Acre (Quintals)	8	7	88

Table IV

Labour Input per Acre on Modern Technology (Manhours)

	Bullock Farms	Mechanised Farms	Index of Mechanised Farms Bullock Farms = 100)
Number of Farms	40	35	
Agricultural Operations			
Preparatory Tillage (Ploughing)	64	40	63
Sowing and Transplantation	16	8	50
Application of Fertiliser	136	88	65
Weeding	64	72	113
Irrigation	56	8	14
Harvesting	48	32	67
Crushing and Threshing	56	40	71
All Operations	488	288	59
Output per Acre (Quintals)	14	11	79

modern technology (Tables 1 and IV). This is perhaps due to the fact with more employment under bullock farms, it might be possible to practise weeding operations, apply irrigation and fertiliser and above all to have personal supervision more intensively and efficiently.

It is interesting to note that labour utilisation and wheat production per acre were the lowest on mechanised farms using traditional technology (Tables II and III). Under mechanism farming using traditional technology, labour utilisation is substantially reduced in the operations like preparatory tillage, transplantation, irrigation, harvesting, threshing and so on (Tables III and IV). In the cultivation of HYV wheat, the reduction in employment under mechanised farming was found to be nearly 41 per cent.

Wheat output under modern technology was 75 per cent and 57 per cent higher than traditional wheat yield on bullock farms and mechanised farms respectively. The increase in output was mainly due to increased irrigation, increased use of fertiliser, better seeds, greater weeding and more intensive agricultural practices under modern technology. Wheat output per acre was found to be lower on mechanised farms than that on bullock farms under both traditional and modern technologies. The highest wheat output was obtained on bullock farms using modern technology (14 quintals of wheat per acre).

It is now possible to determine the optimal combination of different technologies and techniques to maximise both employment and output with reference to Punjab agriculture. For ascertaining such a combination, it is necessary to consider the whole array of combinations alongwith their employment and output effects. This has been depicted in Fig. I which reveals four alternative combinations of technologies and techniques.

As Fig. I reveals, for maximising both output and employment, it is necessary to combine modern technology with bullock technique (D). This will create 488 man-days and 14 quintals of wheat per acre. In terms of employment and output, while combination D yields the best result, combination A seems to be the worst. The possible combinations can be

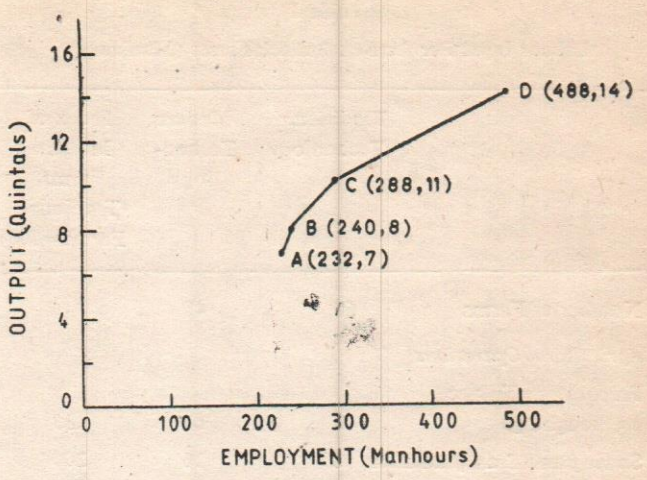

Fig. 2

arranged in the following order with respect to their employment and output effects :

$$D > C$$
$$C > B$$
$$B > A$$
$$\therefore D > A$$

In other words, biochemical technology remaining traditional, a change from mechanised to bullock power technique will augment production and labour utilisation. If biochemical traditional technology is now replaced by modern technology, bullock technique will produce still better result than the mechanised technique. It is interesting to note that in both the cases, bullock power technique retains its superiority.

Conclusion

For the wheat production in Punjab, employment and output per acre can be maximised by adopting bullock farming tecnnique in conjunction with modern biochemical technology. On the contrary, if the biochemical technology is traditional and mechanised farming technique is practised, output and employment in the wheat production would be the lowest. Mechanised farming reduces not only employment but also output per acre. For maximising both output and employment, bullock power technique yields a far better result and, seems to be a more desired technique of cultivation. As expected, modern technology can and does have higher employment and output effects so far as wheat production in Punjab is concerned.

Productivity
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Appropriate Rural Technology

RAIDU CHALAPATHY RAO

This paper focuses on 'Technology' area with emphasis on the problems and issues connected with the selection of appropriate technology and transmitting the same to the rural industries.

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Introduction

In India a vast majority of the population, especially in the rural areas, which can contribute to productivity given the right opportunity, is now left under—employed and not fully remunerated. Rural and small industries have been suggested as an important programme to bridge this gap. According to Shri B. Sivaraman, on a rough guess, India has to find about 54 million opportunities for employment in the secondary and tertiary sectors by 2000 AD'.

Apparently the following three main objectives are to be achieved through the development of cottage and rural industries.

(i) To eliminate under-employment among the rural artisans/skilled persons.

(ii) To improve the remuneration of those employed in rural industries.

(iii) To provide additional employment opportunities for the rural poor.

The two major vehicles that could take us towards these goals are 'Marketing' and 'Technology'. The major task is to define their role and to effectively and efficiently managing them for achieving the set objectives.

Technology Function

The major function of technology in realising the set objectives through development of rural industries

will be to enable the artisans, already engaged in rural industries, produce and offer goods acceptable to the market in quantities that can give him full-employment and attractive remuneration on a continuous basis. Also the technology should be such that it would contribute for product standardisation/innovation/ deversification and generate additional employment opportunities.

Present Technologies and Problems

The work done by NPC in decentralised sector and for the appropriate Technology Unit, Department of Industrial Development, Government of India, has brought into fore various problems the rural artisans are facing due to limitations in the present technologies. These problems may broadly be categorised on follows :

(i) Problems of low productivity
(ii) Problems of product quality/standardisation
(iii) Problems of drudgery and health hazards
(iv) Product/process limitations
(v) Wastage of raw materials.

Productivity problems are identified in certain operations in respect of many crafts-Ex : pressing of horn with hand-operated equipment (Horn goods of Sarai Thareen, Moradabad district etc.).

Product quality/standardisation problems are also very common with certain crafts. Such problems are identified in the wooden toys made in Amroha, Moradabad District.

One need not elaborate about the drudgery and occupational hazards of certain crafts which generally require muscle power and/or use coal as fuel. For example Tuberculoses is most common among the brassware artisans of Moradabad.

In respect of certain crafts like Blue Pottery of Jaipur it is found that the present technology has certain limitations resulting in product defects like breakage, lead poisioning, Iron defect etc.

A very important finding in respect of the majority of the crafts studied is that there is scope to reduce the consumption of raw materials/inputs. This is very common where 'Coal' is used as an energy input. There is vast scope to save energy (coal) by adopting a better design of bhatti/Kiln.

The above mentioned are the main technology limitations to be tackled immediately. It may be asserted here that the immediate job is to save raw materials, (instead of labour), remove/reduce drudgery and health problems, offer better products at acceptable prices by removing the above mentioned and other related technology problems and adopting appropriate technologies.

What is Appropriate Technology

Much has been written about 'what' is 'Appropriate Technology'. Instead of adding to the confusion we may better come to know as to whose needs the 'technology' has to serve and in what way. The chosen (appropriate) technology has to serve :

(i) Consumers' needs
(ii) Manufacturers/Artisans' needs
(iii) Promotors' needs
(iv) Marketers'/distributors' needs

Technology and Consumers

Consumers always look forward for goods that satisfy their specific needs and they can buy at the price, place etc., acceptable to them. It is for the producers, here the artisans, to adopt technologies that would enable them to fulfill the consumers' needs.

Technology and artisans

Artisans, would desire and adopt technology that they can afford (financial consideration), adopt (his own skill, socio-cultural conditions), benefit from reduction of wastage, removal drudgery and occupational hazards) and psychologically convinced.

Technology and Promotors

The 'Technology' should also serve the interests of the Government and other agencies and middleman.

Whereas the Government agencies, apart from other considerations, would see for the technology that would not cost much and would not eleminate labour, the main consideration of the middlemen be the ultimate product cost and product quality. 'Power loom' is one example where the middlemen are satisfied but not the Government agencies.

Technology and Marketers

Marketers/distributors would always look for higher profits, lesser inventory problems and prompt delivery of the goods from the artisans. The technology has to be free from 'operational problem' etc., to serve these needs.

Transmittal of Technology

NPC studies in the decentralised sector brought into light many problems relating to transmittal of select technologies to rural areas. At the outset, it is observed that the 'technology' selected giving due considerations to the above aspects is in different stages of adoption.

(i) Technology/solutions developed but still confined to laboratories/research centres.

(ii) Technology being successfully experimented/ adopted is some craft centres.

(iii) Technology already being followed in some crafts centres.

Fortunately, for a majority of the (Present) teconology problems 'tested solutions' are readily available. Several problems that hinder the process of passing on these solutions to the rural industries have been identified and given below :

(i) Lack of dissemination facilities

(ii) Lack of co-ordination

(iii) Financial problems

(iv) Adoption problems

(v) Operational problems

(vi) Marketing problems

Dissemination facilities

A majority of the research centres laboratories, it is observed have not taken the responsibility of disseminating technologies/solutions they have developed to the rural industries. Naturally there is delay in dissemination of technology information. There is a feeling that the research institutions generally wait for the artisans to approach them.

Another problems is the lack of trained personnel who can effectively demonstrate the solutions/technologies and if necessary, train the artisans in using the technology.

There is a need for an agency which can take care of the technology dissemination function.

Co-ordination

Fortunately there are many agencies who are willing to contribute for the transmittal of technology to rural industries. For example Khadi and Village Industries Boards provide subsidy, commercial banks provide loan under DIR scheme or other schemes, TRYSEM scheme provides funds for training programmes etc. It is not always the case where one of the agencies would take the lead and co-ordinate the entire work and offer the 'technology package' to the rural industries. Voluntary agencies can co-ordinate such programme, but unfortunately we don't have many. To give an example improved coal bhatti model is available with Technological centre of AIAB, Moradabad but the brassware artisans of Moradabad are yet to adopt it.

Financial Problems

Inspite of the huge amounts set for the development of rural industries many artisans could not provided with necessary funds. Lack of finance is one severe limitation slowing the process of technology transfer. For example artisans having 'pitlooms' could not go for 'frame looms' mainly due to financial limitation.

Adoption Problems

In certain cases where the equipments comprising the technology are supplied adoption problems trawted the process. Adoption problems may further be categorised as technical and non-technical problems. For example the 'ban' makers of Moradabad district who

were supplied with pedle operated ban making machines are not using them due to several reasons like :

(i) lack of training in using them

(ii) lack of conviction about the quality of the machine made 'ban' (trial production).

(iii) failing to see the better productivity with the machine in their initial (untrained) attempts and

(iv) Psychological and social reasons etc.

Operational Problems

Artisans hesitate to adopt technologies susceptible to operational problems. This initial apprenthension on the part of artisans is observed in respect of power operated equipments which give rise to operational and mechanical problems.

Marketing Problems

Like other entrepreneurs, artisans also do not want to go for a change in technology/equipment by investing money and time for securing them and train himself in using them when he is not capable of marketing the produce. With increased production his marketing problems may increase and experience says that he may not be able to secure good prices for his products.

To conclude, it may be said that the basis for the selection of technology will be its adoptability, its contribution to productivity vis-a-vis reduction of drudgery and health problems, its impact on employment and also its contribution in enabling the artisans delivering products suitable to the market needs. Mere supply of new tools and equipments without due consideration of their practical use to artisans and also the contribution to 'employment generation' rather than 'employment reduction' would only draw us away from the cherished objectives.

REFERENCES

1. Address delivered by Shri B. Sivaraman, Member Planning Commission, New Delhi on 4th December 1978, to the deligates of the programme on 'Project Management for rural and Small Industries Development', sponsored by APO, Tokyo and conducted by NPC, New Delhi.

2. NPC project reports on Appropriate Technology.

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1984, XXV, 1, 43-48

Labour Productivity and Technology A Case from Mining Industry

M.R. GUPTA & A. BHATTACHARJEE

In this paper an optimizing model for selection of mine size and technology has been developed with the objective of maximizing labour productivity. Mathematically it is an integer zero-one fractional linear programming problem. A case study has been made in surface mining with Indian data.

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The authors are highly thankful to Dr. D.K. Sinha, Professor and Head, Dept. of Industrial Engineering and Management, Indian School of Mines, Dhanbad, for his valuable ideas and suggestions.

Introduction

One of the important problems in the coal mining industry in India is that the growth rate in labour probuctivity is lower in comparison to the growth rate in wage in 60s and 70s. In this light, the planning for the selection of mine size and technology in surface mining should give special attention to the labour productivity problem.

I. The Problem : Discussion of the choice of technology and mine size problem—

The problem of the optimal selection of plant size and technology is an important problem to the planning authority for any economic sector publicly owned. Coal mining industry is one of the important public sector industries in India. In recent years, the technological structure of the industry has undergone some significant changes. The traditional underground mining methods of board and pillar system are being replaced by underground longwall and large opencast systems which are highly capital-intensive in nature. Since nationalization, substantial investment expenditure has been taking place in this sector. In this process this sector has experienced a significant degree of capital-deeping.

In this paper, we are interested in the optimal selection of mine size and technology in surface mining.

The problem of selection comes in the presence of the availability of alternatives. In surface mining, there are basically two types of mining systems; (1) Discontinuous or cyclic system using either dragline or shovel-dumper or a combination of both, (2) Continuous or non-system using either bucket wheel or bucket chain excavators and belt-conveyors. Different conbinations of equipments of the above two systems are possible for exploitation of mineral reserves having different geomining characteristics. Different techniques must have different capital-intensity depending on the mine size but the optimality of selection of mine size and technology must be examined from the two different and conflicting view points.

(i) The rapid industrialization programme in India and the recent energy crisis in international economic scene has led to the policy of meeting the demand for coal from its own reserve. In future, demand for coal is expected to be increased at a very high rate. In this light productivity in coal industry should be an important consideration in the selection problem. The consideration of productivity always favours the introduction of advanced technologies which are highly capital-intensive in nature.

(ii) India is a labour-surplus and capital-scarce economy. Also the ultimate goal of the planned developed programme of the country is to estiblished a socialistic pattern of society with a fair degree of economic equality. In this light labour intensive technology appears to be more important than the capital-intensive technology.

So while going to the selection problem, the planner must take care of the different constraints coming from the economic structure of the country and the economic policy of the Government.

The selection is optimal when it optimizes a particular objective and the choice of this objective is another problem in a less-developed economy like India. During the plan period, Indian economy, on the one hand, has experienced a significant degree of capital-deepending and the employment problem has been neglected. On the other hand, labour-cost has been increasing at a high rate in most of the public sector industries without any significant improvement in labour productivity. Since nationalization, this problem has reached its extreme stage in coal mining industry In this light, the objective should be either maximization of labour-productivity or minimization of capital-labour ratio or both. Selection among the objeetives in obviously subjective to the planner.

In this paper, we have developed an integer fractional programming model for selection of mine size and technology in surface mining with an objective of maximizing labour productivity subject to different constraints related to demand for coal, shortage of fund required to purchase the capital goods and the consideration of unemployment. Section II is devoted to an analysis of trend in labour productivity and wage in Indian coal mining industry during 1960s and 1970s. The theoretical model is formulated in section III and the concluding remarks are given in section IV.

II. Analysis of Labour Productivity and wage :

Data of labour productivity and wage have been callected for the last two decades from 'Annual report of the statistics of mines in India for coal'. Labour productivity has been defiend as indices of gross value of output per employee in coal sector and wage has been defined as indices of labour earning. The Table 1 shows the trend in labour productivity and wage from 1961 to 1976.

Table 1

Year	Y/L	Ln Y/L	W	Ln W
61-62	68.80	4.2312	44.65	3.6988
62-63	75.56	4.3249	46.00	3.8286
63-64	75.58	4.3252	49.96	3.9112
64-65	76.89	4.3424	50.27	3.8174
65-66	85.38	4.4471	58.34	4.0663
66-67	86.05	4.4549	64.43	4.1656
67-68	89.07	4.4894	86.75	4.4630
68-69	98.54	4.5905	91.99	4.5217
69-70	104.07	4.6451	94.12	4.5446
70-71	100.00	4.6052	100.00	4.6052
71-72	103.10	4.6357	103.00	4.6345
72-73	101.62	4.6212	110.65	4.7064
73-74	70.03	4.2489	135.97	4.9051
74-75	94.32	4.5467	162.05	5.0879
75-76	102.64	4.6312	225.68	5.4191

Where, Y/L = Indices of gross value of output (at 70-71 prices) per employee in coal sector (Base 70-71=100)
W = Indices of labour earnings (Base 70-71=100).

Regression model is fitted with productivity data taking logrithm of productivity as dependent variable. and time as a independent variable. Growth rate of productivity has been estimated as .02 and the co-efficient of correlation between the two variables has been found as .93.

Another regression model is fitted with wage data over time. Growth rate of wage has been estimated as .10 and the co-efficient of correlation has been determined as .99.

It is evident from the above anaylsis that the labour cost has been increasing at a substantial rate without any significant improvement in labour productivity. Under such circumstances it is all more prudent to opt for a technology which maximizes labour productivity subject to different constraints inherent in the system.

III. Technology selection Model

A Case Study :

(a) Problem Identification : We have identified the problem of technology selection in surface mining where different reserve block are widely dispersed and are represented by different geo-mining conditions. For the simplicity in data preparation, we assume, selection of a single large project in each reserve block. As there exists a number of feasible alternative technology combinations and their corresponding mine sizes for each reserve block, our objective is to find out which technology and the corresponding output level is suitable for each of the reserve blocks under- consideration so as to optimize labour productivity within a set of constraints as technological constraint, demand constraint, inverstment constraint and man-power constraint.

While calculating the investment requirement, the amount to be deployed for plant and equipment has been taken into account leaving aside infrastructural investment. The volume of output is taken as the sum of the coal produced and overburden removed because these two as a whole determine the machinery requirement in the mine.

(b) Formulation of the Problem : The mathematical programming model developed to select optimal technology and the corresponding mine size is a fractional linear programming with zero-one variables. The zero-one variables in the model are purely logical in nature, that is, they depict a go-no-go situation.

Notations used for the model formulation :—

i = Reserve block or mining block

j = Mine size or production capacity

k = Technology

m = Number of reserve blocks

p = Possible number of production capac ities

n = Number of alternative technology

P_{ijk} = Annual coal production excluding over-burden from the ith reserve block, jth production and kth technology is selected.

L_{ijk} = Required manpower for ith reserve-block, if jth production capacity and kth technology is selected.

I_{ijk} = Investment required for plant and equipment for ith reserve block, if jth production capacity and kth technology is selected.

Q_{ijk} = Output including overburden from ith reserve block if jth mine size and kth technology is selected.

P = Annual demand for coal including all reverve blocks.

I = Maximum amount of investment that can be developed including all reserve blocks.

L = Minimum number of manpower to be employed in these m reserves.

Decision variable :

X_{ijk} = A variable taking values either 1 or 0. If $X_{ijk} = 1$, it implies in ith reserve block jth mine size and kth technology has been selected, otherwise $X_{ijk} = 0$, and it implies above combinations are not selected.

Optimizing Criteria : We plan for a particular size of mine in each of the reserve blocks and at the some

technology to be adopted for that size of mine so as to maximize labour productivity within a set of constraints inherent in the system of planning and decision making. Labour productivity can be defined as a ratio of total output to total manpower employed.

Total output from all the reserve blocks

$$= \sum_{i=1}^{m} \sum_{j=1}^{p} \sum_{k=1}^{n} Q_{ijk} X_{ijk}$$

Total manpower employed in all the reserve blocks

$$= \sum_{i=1}^{m} \sum_{j=1}^{p} \sum_{k=1}^{n} L_{ijk} X_{ijk}$$

Hence labour-productivity is defined by

$$Z = \frac{\sum_{i=1}^{m} \sum_{j=1}^{p} \sum_{k=1}^{n} Q_{ijk} X_{ijk}}{\sum_{i=1}^{m} \sum_{j=1}^{p} \sum_{k=1}^{n} L_{ijk} X_{ijk}}$$

Constraining relations :

Technological Constraints : Constraint to ensure selection of only one mine size and technology in one reserve block. This contraint implies, for example in first reserve block there will be selection of only one mine size and one technology and similarly for other reserve blocks.

Mathematically it can be expressed as—

$$\sum_{j=1}^{p} \sum_{k=1}^{n} X_{ijk} = 1 \text{ for } i=1, 2, \ldots\ldots, m.$$

Demand Constraint : This constraint implies that total coal production per annum including all reserve blocks should meet the targetted coal production; mathematically —

$$\sum_{i=1}^{m} \sum_{j=1}^{p} \sum_{k=1}^{n} P_{ijk} X_{ijk} \geqslant P$$

Investment Constraint : This constraint implies that the total requirement for capital in all the reseve block should not exceed a certain level. An upper limit on the availability of capital should exist as India is a capital scarce economy. Mathematically it is,

$$\sum_{i=1}^{m} \sum_{j=1}^{p} \sum_{k=1}^{n} I_{ijk} X_{ijk} \leqslant I$$

Manpower Constraint : The constraint implies that the total Manpower employed in all the reserve blocks should be greater than equal to certain level as India is a labour surplus economy. Mathematically it can be expressed as—

$$\sum_{i=1}^{m} \sum_{j=1}^{p} \sum_{k=1}^{n} L_{ijk} X_{ijk} \geqslant L$$

(c) Solution to the model : The model has been linearised using Wagner's[4] direct linearisation method and the model changes to a mixed integer linear programming problem. The model is tested with a case study and it has been made through collection of data from different ongoing projects in India whereby a number of feasible alternative technology combinations and their corresponding mine sizes have been identified and are applied to four new mining blocks for optimal technology selection. Each of the alternative technology combinations are characterised by investment requirement and manpower deployment in a project and the generalised representation is shown in Table 2, however, detailed discussion of the alternative technology combinations are beyond the scope of this paper.

For our case study, we have identified twelve alternative technonolgy combination and four mine sizes as 3 million tonnees, 9 million tonnes and 12 million tonnes of coal per annum respectively. These alternative technology combinations and mine sizes have been applied to four mining blocks as B_1, B_2, B_3, and B_4 having different geomining conditions.

(i) Data preparation for the model : The output

Table 2

Technology / Output	T_{j1} j=1, 2, ..., k	T_{j2} j=1, 2, ..., k	...	T_{jn} j=1, 2, ..., k
P_1	L_{11}	L_{12}		L_{1n}
	I_{11}	I_{12}		I_{1n}
P_2	L_{21}	L_{22}		L_{2n}
	I_{21}	I_{22}		I_{2n}
⋮				
P_k	L_{k1}	L_{k2}		L_{kn}
	I_{k1}	I_{k2}		I_{kn}

Where, P_j = Achievable capacity of a project j, for j=1, 2,..,k;
T_{jn} = Technology combination for jth capacity project and nth alternative technology;
L_{kn} — Manpower development for P_k capacity project in which T_{kn} technology has been selected;
I_{kn} = Investment required for P_k capacity project in which T_{kn} technology has been selected.

level-technology matrix, which shows for a particular production the choices of different technology combinations depicted by investment requirement and labour employed for each combition, is presented in Table 3.

Table 3

Technology / Output	T_{j1} j=1, 2, 3, 4	T_{j2} j=1, 2, 3, 4	T_{j3} j=1, 2, 3, 4
P_1	2055	1150	2961
	63.84	72.375	55.317
P_2	3635	3903	3350
	121.18	130.87	111.50
P_3	3005	2100	1900
	91.95	96.58	87.33
P_4	4815	5200	4430
	164.60	171.57	157.645

Where, Upper slot represents manpower (L_{jk}) in number of persons and lower slot represents investment (I_{jk}) in crore rupees.

Details of the mine sizes are as follows :

P_1 = 3 million tonnes + million cubic metres of overburden.

P_2 = 9 million tonnes + million cubic metres of overburden.

P_3 = 5 million tonnes + million cubic metres of overburden.

P_4 = 12 million tonnes + million cubic matres overburden.

Detailed of the newly identified reserve blocks are as follows :

B_1 = 128 million tonnes of coal + million cubic metres of overburden, stripping ratio—1:1.76

B_2 = 84 million tonnes of coal + million cubic metres of overburden, stripping ratio—1:2.25

B_3 = 154 million tonnes of coal + million cubic metres of overburden, stripping ratio—1:3.2

B_4 = 360 million tonnes of coal + million cubic metres of overburden, stripping ratio—1:3.5

Right hand side constraints : The values of the right hand side constants of the constraining relation namely manpower constraint, invesment constraint and demand constraint are assumed arbitrarily in our model. In reality, the limits of these constraints should be decided by the decision maker. In our problem, the lower limit of manpower has been taken as 10,000 and that for investment upper limit has been chosen as 650 crore rupees. The targetted coal production has been fixed up meeting the consumer's demand against the constraint inherent in the availability of resources, supplies and available technologies and in our model the demand for coal from all the four reserve blocks has been fixed at 25 million tonnes.

(ii) Realisation through Computer : The model has been solved using TEMPO mathematical programming system package on a Burroughs Computer and the optimum result is as follows :—

(a) The technology selected for the mining block

B_1 is T_{12} which includes dragline for overburden removal and shovel-coal hauler combination for coal removal. Planned production from this project would be about 3 million tonnes of coal annually for the above technology combination.

(b) The technology combination for the mining block B_2 is T_{12} which employes draglines, shovels, coal haulers, drills, dozersand graders as the main equipments. Annual production from this project would be about 3 million of coal for the above technological implementation.

(c) Mining block B_3 uses bucket-wheel-excavators, draglines, shovels, coal haulers and front-end-loaders as the main equipments. The technology selected for the above equipment combinations is T_{43} and annual production from this block is about 12 million tonnes of coal.

(d) The technology selected for the mining block B_4 is also T_{43} which deploys a combination of continuous and discontinuous mining system using bucket-wheel-excavators and draglines for overburden removal and shovel-coal hauler combination for coal removal. Planned pro-production from this mining block would be 12 million tonnes per annum.

Conclusion

The solution established a decision for the management which can be implemented in a given planning horizon to yield optimum results maximising labour productivity and at the same time satisfying production targets within the limitation of capital and trained manpower available.

The model which forms the core of this paper has been solved with representative data in a small scale. In reality, however, extensive collection of data is necessary since all the reserve blocks of the coal mining industry are to be considered apart from different output levels and technologies. Sensitivity analysis of the model can be carried out as the management decision in reality would not only be interested in the optimal solution of the established model but also in how the solution and decision would vary with the changing parameters of the problem.

REFERENCES

1. Bhattacherjee, P.S. : Productions and Productivity in coal industry—An optimization problem, Mine Tech, CMPDI Publication, Vol. 2, No. 4, 1977.
2. Directorate-General of Mines Safety : Statistics of Mines in India, Vol. 1—Coal, Various Issues.
3. Goel, V.K. & Nair, N.K : Labour productivity and output growth in India Mining and Manufacturing sectors during 1951-76,—Productivity, NPC Publication, July—September, 1979, Vol XX, No. 2.
4. Wagner, Harvey M : Principles of Operations research, Prentice-Hall of India Pvt. Ltd., 2nd edition 1980.

Productivity
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Developing Rural Industries

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The most important step in rural industrialisation will be to identify entrepreneurs and "develop" them. The work is difficult but not an impossible one. It needs talented, experiened and dedicated persons who can bring a change in the social structure of the villages and increase the industrial activities and incomes of villagers.

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The concept of District Industries Centres (DICs) was an outcome of the New Industrial Policy of the Government of India (GOI) which was announced in the Parliament of December 23, 1977. The idea behind this was to reduce unemployment and ensure a more rapid bridging of the existing disparities in income and wealth as well as to provide workable solutions to the nations' endemic problems. The DICs are the centrally sponsored schemes of the GOI implemented by the State Governments. The DICs started functioning in the country in May 1978.

The DICs function as a decentralised, autonomous and responsible instruments to achieve the task of industrial and entrepreneurial development and as a cause to eliminate and reduce the organisational weaknesses and functional inadequacies which their predecessors—Rural Industries Projects and District Industries Offices have suffered from. DICs have been designed as comprehensive agencies with most of the functional elements and functionaries that are necessary for speedy rural, entrepreneurial and industrial development.

A major structural innovation of this agency is to deal with all the requirements of Small and Village Industries under one roof in order to achieve the objectives of Rural Industrialisation by generating maximum possible employment opportunities in rural areas and small towns especially for weaker sections of the community so as to enable them to improve their standard of living.

Personnel

The most important step in rural industrialisation will be to identify entrepreneurs and "develop" them. The work is difficult but not an impossible one. It needs talented, experienced and dedicated persons who can bring a change in the social structure of the villages and increase the industrial activities and incomes of villagers.

In view of meeting the needs of the rural entrepreneurs the DICs have been restructured with a General Manager (GM) and four Functional Managers (FMs). Three of the FMs will be in the field of Economic Investigation, Credit and Village Industries respectively. In respect of the fourth FM, the State Governments will be free to choose from any one of the areas of Raw Materials, Marketing, Training, Information and Infrastructure depending on the specific requirements of the particular district.

The FM (Village Industries) will be the key functionary to look after the components of Integrated Rural Development Programme (i.e., ISB and TRYSEM) alongwith other FMs. In addition he also utilises the services of the Project Managers (Technical Experts) in carrying out the policies and programmes which are related to the rural industrialisation.

For the purpose of ISB, TRYSEM, artisans and entrepreneurs, he also supervises to collect the information on the prospects of various industries through industrial potential surveys and statistical data from all available sources.

Training

In view of adequate orientation of DIC personnel towards the complex problems of small and village entrepreneurs and expeditious development of small industries in rural areas, special training programmes were designed and organised at various training Institutes with the help of well known national organisations and reputed progessional institutions in the country. To this effect some of the State Institutions of Public Administration have started imparting training and where they are not available new ones were created.

Extensive training has been undertaken in order to equip all the GMs with the right attitude for the tasks at Small Industry Extension Training Institute (SIET), Hyderabad and at Indian Institute of Management (IIM), Ahmedabad. So far nearly 150 GMs and 732 FMs have been appointed, of whom 136 GMs and 472 FMs have been trained. Various Institutions where the training programmes conducted for FMs are : IIM, Ahmedabad; SIET Institute, Hyderabad; National Productivity Council; Industries Development Corporation; Birla Institute of Technology; and State Bank of India. Apart from training the SIET Institute has also conducted workshops for top DIC personnel to discuss the issues concerned with the implementation of policies, programmes and strategies pursued for decentralised industrial development and the effectiveness of tools and techniques used for industrial promotion at the block, district and regional levels.

IRD and its Implementation through DICs

The Integrated Rural Development (IRD) Programme is actually a synthesis of strategies tested and found effective from the experience of implementation of social programmes for the development of small and marginal farmers, agricultural labourers, rural artisans etc. The programme has gone to the grass-roots level by adopting families as basic units of development.

ISB : The Industries Services and Business (ISB) component of IRD covers 100 families under industries and 100 families under services and business per annum. It involves identification of beneficiaries, their training, provision of all essential inputs and their nursing till they are able to stand on their own feet. On the other hand the DICs have also involved itself in the task of helping the people who are at the grass-roots level and became part and parcel of the overall strategy of implementing IRD programmes.

The basic objectives of the DIC and ISB of IRD being the same, the two programmes are complementary to each other; the only difference being that the scope of the ISB component is limited to the target group of 200 families per annum, while DICs cater to a larger group to which the ISB target group is an essential and important component. All technical and

administrative support for the ISB target group is to be provided by the DICs.

Trysem : The other component of IRD the Training of Rural Youth for Self-Employment (TRYSEM) was launched by the Department of Rural Development with the main objective of training at least two lakh rural youth every year in agricultural and allied sectors and small indusiries for self-employment, skill formation and upgrading. The programme was initiated in August 1979. TRYSEM as an integral part of IRD programme concentrates on providing training to rural youth between the ages 18-35. The DICs have been assisting the IRD and TRYSEM authorities in selection of beneficiaries from amongst the target groups and in making adequate arrangements for their training as well as their follow up. Generally the progress made by the TRYSEM Programme is found to be encouraging. It was observed that the institutions selected for imparting training under TRYSEM Programme such as ITIs, Polytechnics were not capable of giving training that would help. The trainee to set up his own enterprise. It was felt that the training imparted by the Master Craftsman should be more practical and purposeful.

In this connection the DICs can extend their cooperation to IRDs in organising the training programmes, selection of institutions for training, selection of beneficiaries, working out syllabus for the training programmes, preparation of project profiles and technical and other assistance during the training period. And after the training all assistance required in the shape of tool kits, industrial accommodation, raw materials, credit and other assistance may be provided by DICs to the interested parties in setting up of new industries.

Need for coordination : Although a large number of agencies concerned with the development of village and small scale industries had come up at various levels, the District Industries Office remained perhaps the weakest link of the chain. The numerous schemes, ageneies and organisations lacked cohesion and coordination.

The DIC framework has been designed to remove these bottlenecks and take up in a systematic manner the programme of identifying new enterpreneurs in rural areas. Once such identification is made, the DICs could provide all assistance from a single window. In the DICs, a critical mass of personnel and capabilities are being provided which could bring about rapid growth of industries in the district. The promotional components of the erstwhile Rural Industries Projects (RIPs) and Rural Artisan Programmes (RAPs) have also been merged with the DIC programme.

It has been found that in most of the areas, the DICs and IRDs are working in collaboration with each other. However, to achieve the ambitious targets set out, it is imperative that all loose ends are closely tied up. This could be accomplished by streamlining institutional and administrative tie up as well as close integration in implementation of the two programmes.

The basic objective of such a close tie up is to evolve mutual programme of coordination and support for the speedy promotion of small and village industries. Such a tie up can be effected not only at the field level but also at the District, State, Regional and Central levels. Although necessary instructions have been issued from time to time by both the Ministries of Industry and of Rural Reconstruction, it has to be ensured that the GM of the DIC is included as member of the governing body of IRD and Officer In-charge of the IRD programme as a member or the District Advisory Committee for the DIC programme. Similar arrangements can be ensured at all levels.

Linkages with KVIC

The DICs are also maintaining close linkages with Khadi and Village Industries Commission (KVIC) and other concerned agencies which are parelelly playing vital role for the promotion and development of rural industries. Close linkages with all these agencies at Block, and other levels the DICs can implement and evolve a mutual programme of coordination and support for speedy promotion of small and village industries.

Gap to be filled: It was observed that there is a wide gap to be filled under village industries sector. Because, KVIC looks after the promotion and develop-

ment of certain industries* only. Secondly, only about 1/5th of the five lakh villages have been covered by the KVIC. Thirdly, the district organisational set-up of the KVIC is too small to cater to the needs of entire district. Lastly, the expenditure on village industries out of KVIC provision seems to be very small for the vast needs of this sector for the country as a whole.

In view of filling the gap, the DICs have already started inducting the representatives of KVIC to associate with it at every level for effective coordination. It was observed that except in few states the linkages between State KVI Board officials and DICs are not uniform throughout the country and it is suggested that adequate linkages between these two agencies for all states is yet to be evolved.

Linkages with other Agencies

It is felt that a well coordinated and precise working relationship is yet to be established between the DICs and other agencies† functioning for the development of decentralised sector. A major obstacle to speedy implementation of programmes in this sphere is the presence of large number of agencies doing similar jobs with different patterns of financial and other assistance. If DIC is recognised as a model agency at the district level for development of small scale sector including the tiny, artisan based cottage and village industries, a practical working relationship has to be devised as the sporadic contracts are not enough. The DICs have to be evolved from the planning process to implementation stage. It is not the intention that DICs should be the only channel for implementing the programmes in the decentralised industrial sector. Wherever other agencies have been independently functioning, the DICs need not interfere with them. But the DICs should be kept informed about what is happening and should involved in all process of planning and implementation. Secondly, it is felt that there are many areas where the presence of these agencies is still not felt and the DICs can enter into these areas either on itself or on behalf of the concerned organisations to carry out the programmes.

It is for consideration how the gaps in coordination between the DICs and other concerned agencies have to be filled up with a clear cut policy for development of decentralised industrial sector and how the DICs can be fitted into the policy pattern.

20 Point Programme and Rural Development

The revised 20-point programme enumerated by the Prime Minister of India lays direct emphasis on the development of villages and small industries and also would employ such development for the purpose of achieving several other targets enunciated in that programme. Thus, on the one hand development of Khadi and Village Industries and Small scale industries

*1. Process of cereals and pulses
2. Ghani Oil
3. Village leather
4. Cottage match and agarbathi
5. Sugar, canegur and Khandsari
6. Palmgur and other palm products
7. Non-edible oils and soap
8. Beekeeping
9. Village pottery
10. Handmade paper
11. Fibre
12. Carpentry
13. Blacksmithy
14. Lime manufacture
15. Gobar (methane) gas
16. Collection of forest plants and fruits for medical purposes
17. Shellac
18. Gum and resins
19. Kathe
20. Fruit proeessing and preservation
21. Bamboo and cane work
22. Aluminium utensils
23. Polyvastra and
24. Lokvastra

† Such as All India Handicrafts Board,
All India Handloom Board
Central Silk Board
Coir Board
Department of Rural Development
SIDO
SIET Institute
Nationalised Banks
Technical Consultancy Organisations
NSIC
State Level Agencies and Corporations, and
District Level Agencies.

in the rural areas is by itself an important objective and its success on the other hand will largely depend upon the extent to which the product of industry as also the industrial input is related to other sectors of the economy. Production of agricultural implements needed in the area, production of other gadgets required for optimising the benefit from available irrigation, enhancing the utilisation of irrigation potential, will require industrial inputs. The DIC would be in the best position to affect such integration with all other priority objectives enunciated under the 20-point programme. It is necessary that the DICs should chalk out a specific programme of action for streamlining the procedures and rendering long term and efficient services. Selection of suitable projects, identification of entrepreneurs, entrepreneurial development programmes, technical training, raw material management, marketing support are all areas in which specific action to be taken in each DIC, should be clearly outlined.

According to the reports received from 324 DICs during 1980-81, 237,564 new units comprising 1,77,236 artisan-based and 60,328 SS units were established. These units provided employment opportunities to over 8.07 lakh persons. The credit assistance provided by financial institutions amounted to Rs. 286.80 crores, on an average per DIC, during the period from April 1980 to March 1981, 73 units have been established generating additional employment opportunities for 2,491 persons. Credit assistance provided by financial institutions amounted to Rs. 0.89 crores per DIC.

During the 1981-82 the likely achievements in 384 DICs is estimated to 3,05,600 new units comprising 2,29,200 artisan-based and 76,400 small scale units would be established generating additional employment for 10.47 lakh persons. Credit assistance amounting to Rs. 374.36 crores would be provided by financial institutions.

Role of DICs in Marketing Programme

Marketing occupies a strategic place in the present day economic system. Over the years the character of market has changed from the seller's market to buyer's one. The small scale units particularly tiny ones have to depend mostly on middlemen for marketing their products as the former do not have a proper marketing organisation of their own.

So, the DICs can be considered to render assistance and support to village and small industries in marketing their products as the marketing is one of their functionaries. To evolve and implement marketing strategies the DICs are expected to undertake the following activities.

(i) To identify suitable units and products for marketing;

(ii) To conduct market survey and studies for determining marketability of the products and ascertain suitable market outlets;

(iii) To provide marketing intelligence by liaisoning with different agencies and pooling the information based on market studies;

(iv) To develop and organise marketing outlets and maintain a close and effective liaison with small industrial enterprises;

(v) To help and assist small and village industries in maintaining and developing standards, quality control measures and liaisoning with testing centres/houses;

(vi) To operate the programme of mini trade centres and showrooms for exhibiting products of decentralised industries; and

(vii) To assist village and small industries for participating in the purchase programmes of Government of India, State, Local bodies and Public undertakings.

In implementation of programme, the DICs shall have close links with the state Small Industries Development Corporations, Consultancy organisations, the National Small Industries Corporation and specialised agencies undertaking the marketing assistance programme.

Conclusion

The two programme—DICs and IRD represent a new determination to tackle the formidable task of speedy development of small industries and providing gainful employment opportunities in rural areas. The success of this great endeavour would depend to a large extent on the solid foundations that are laid through pragmatic programme of action and close integration

between the two programmes The extension personnel should, therefore, fully realise the great responsibility they have to shoulder in this pioneering task and should try to utilise the resources and residues from agriculture. For marketing the products manufactured in rural sectors, the DICs should be useful functionaries between the units and the potential purchasers and users, by organising retail outlets through established agencies like super bazars and marketing associations or on its own. And if adequate working relationships between the DICs and other promotional and developmental agencies like KVIC are evolved, India can really achieve self-sufficiency in every respect within a short span of time and can minimise to a large extent the migration of rural populace to urban areas.

REFERENCES

1. Bendre, S.D: Development of rural areas, Small Industry and Business Today (SIB), 1980, 1(12), 28.
2. Chopra, K.C: Financing the decentralised sector, SSI Magazine, 1979, 4(11), 26-27.
3. DC (SSI): Agenda Notes. All India Conference of general managers of district industries centres (July 19-21, 1982), New Delhi 1982.
4. Desingusetty, E and Parameswaran E.G: Behavioural approach to district industries centres, SEDME, 1979, 6(4), 250.
5. India DC(SSI): A handbook for extension services-rural industrial development, DC(SSI), Ministry of Industry, Government of India, New Delhi, 1980.
6. Report 1981-82, Ministry of Industry, GOI, New Delhi, 1982, 42-43.
7. Srivastava, S.B.: A practical guide to industrial entrepreneurs, Sultan Chand & Sons, New Delhi, 1981.

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Appropriate Technology and Small Enterprise Promotion

PAUL BANGASSER

A great deal has been written concerning appropriate technology over the past few years. It is now generally recognised that technological innovation has a major bearing on such national development objectives as employment creation, income distribution and the satisfaction of basic human needs. What is needed is a technological mix "which leads to optimum use of available resources in a given environment," optimum being defined as the maximisation of social welfare if capital, labour and finished goods are all priced at their social costs. Advocating small enterprise promotion, the author explodes a lot of myths pervading against the same.

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Appropriate technology and small enterprise promotion

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By its nature, promoting small independent enterprises implies that control over the operations of firms remains in the hands of the small-scale entrepreneur. Consequently, the public authority has relatively less

1. D. Morawetz, "Employment implications of industrialisation in developing countries : a survey", *The Economic Journal*, London, Macmillan Journals Ltd., Vol. 84, No. 335, Sept. 1974, p. 517.

2. The question of appropriate technology is an extermely complex and multi-faceted on. Doing it justice is far beyond our scope or means here. For the Sake of simplicity and ease of expression, we use word "technology" both in the sense of specific production techniques and also in the more general sense of the state of industrial art. The context will normally make the sense clear. For an excellent treatment of the broader issues of technology, the interested reader is referred to F. Stewart; Technology and Underdevelopment (London, The Macmilian Press Ltd., 1977).

national cultural identification. In practice, therefore, and with appropriate allowance for variations in national priorities and in the role to be played by small-scale enterprise in achieving these priorities, the planner can be expected to prefer technological change which (a) increases productivity; (b) complements labour rather than replaces it; (c) produces low-income goods and services for the "poor masses"; (d) utilises local raw materials and can be produced, maintained, and repaired by the domestic capital goods industry; (e) improves the efficiency of existing production capacity; (f) encourages the channelling of hoarded or latent savings[8] into new productive investment; and (g) is compatible with existing mores and social patterns.

Finally, and most fundamentally, the planner seeks technical innovation which promotes a certain level of inter-firm competition as a prod both for productivity and for further innovation, whereas, the small entrepreneur (particularly the more sophisticated small

top quality goods for a sophisticated affluent margket, to utilise synthetic or highly processed "raw" materials, is horrendously expensive when compared to local income levels, and assumes attitudes and work habits inconsistent with local traditions. It is, in a word, inappropriate. Perhaps some of its labour-saving peripheral features can be shaved off. Perhaps it can be adjusted to use more local raw materials. Perhaps we can find a cheaper wintage or a second-hand model. Yet short of giving up the battle altogether, it seems the only serious short-term option available.

To be sure the lines of this dilemma are drawn more sharply than they exist in reality. "Traditional" technologies are not static. "Modern imported machinery" is not an indivisible lump which must be accepted en masse or not at all. All imported machinery is not necessarily modern; and all modern techniques are not necessarily imported. Nevertheless there is enough evidence of obviously inappropriate investment decisions on the part of both private and

of the particular production technique being utilised. The careful analysis both of productivity levels and of their increases shows that production technologies and technical innovations are at best only minor factors. The ILO productivity missions in the late 1950s achieved increases in labour productivity averaging nearly 80 per cent without introducing any technological changes but simply by improving plant layout, machine utilisation and flow, materials handling, waste control, work methods, payment by results and worker training and supervision.[16] Even in industrialised economics. aggregate increase in the fixed assets (including land and building as well as machinery) accounts for less than one-seventh of the growth in national income.[17]

A corollary myth is the frequent assumption that the most effective way to increasing a particular industry's productivity is to "modernise" its technology. From the evidence just presented, it is clear that there is very substantial room for increasing output and productivity on the existing technological base. On the other side of the coin, there is also good reason to suspect that efforts to improve an industry's performance through the introduction of a major technological change will prove to be much more costly and of much more ambiguous benefit than originally expected.[18]

Myth No. 3—There is a single optimum "lowest unit cost" production technique for any given product. This myth likewise seems to arise from the planner/administrator/economist's underestimation of how variable, uncertain and interdependent the techical aspects of production are. The decision to "lead" an assumedly backward industry towards this optimal production scale starts one off "inventing a variety of enterprises, specifying each in considerable detail as to products, technologies, scale, location, markets, finance (*and*) management. Then for each such figment he must consider the things that can happen to it, if he does bring this particular figment to realisation. And this task is endless".[19] Even setting a side contingencies of a political and commercial nature, the number of possible combinations of techniques and equipment already available is immense: and both the stock of techniques and the stock of underlying knowledge is increasing constantly. In short, a rational comprehensive search for "the optimum technique" is an open-ended exercise, and probably futile in any case. Available evidence suggests that long-run average cost curves are not "v" shaped as implied, but are actually "U" shaped with a fairly broad flat bottom. Thus any one of several alternative techniques, each with its particular scale of operations, can achive virtually the same average total unit costs of production.[20]

Furthermore, as we have already mentioned, organisation, entrepreneurial and commercial factors are easily of equal importance as technical factors in determining an enterprise's optimum scale of operations.[21] These factors are often highly enterprise-specific and may vary widely among enterprises operating within the same basic environment. Thus, at any one

16. See also "ILO productivity missions to underdeveloped countries", *International Labour Review*, July and Aug. 1957. In some instances, simple technical alterations were also introduced, but if these cases are excluded, the average increase in labour productivity actually rises to 83 per cent ! see also p. Kilby. "Organisation and Productivity in backward economics," *Quarterly Journal of Economics*, May 1962.

17. E.F. Dension (why growth rates differ, Washington D.C., Brookings Institution, 1967 (pp. 299 and 301) found that "Non-residential structures and equipment" was the source of 13 and 14 per cent on growth of national incomes between 1950 and 1962 for the United States and north-west Europe. respectively. He also atributed 23 and 16 per cent to "advances in knowledge", but this includes "management knowledge" as well as technical knowledge and he concedes that "advances in managerial knowledge may easily contribute as much or more to measured growth as advances in technical knowledge".

18. This phenomenon has been documented by many authors and over a considerable time span, and our performance does not seem to be improving markedly. Cf. P.M. Glick, The administration of technical assistance (Chicago, University of Chicago Press, 1957): A.O. Hiraschman, Development projects observed (Washington D.C., Brookings Institution, 1967) : M.P. Millikan and D. Hopgood, No easy harvest (Boston, Little, Brown and Company, 1967) ; W. and E. Paddock, we don't know how—an independent audit of what they call success in foreign assistance (Aimes, Iowa; Iowa State University Press, 1973); J. Tendler, Inside foreign aid (1976).

19. G.L.S. Shackle, "Policy, poetry and success" in Cn the nature of business success (Liverpool, Liverpool University Press, 1968), p. 5.

20. F.M. Scherer, op. cit., pp. 75-85.

21. E.A.G. Robinson, op. cit.

point in time there will normally be a variety of techniques and sizes of enterprises all effectively competing with each other within a given industry. Even in the rare case where several firms are all using the same techniques and equipment, there is little evidence to assume that they will all achieve approximately equal productivity. For example, among five rubber-creeping firms in Nigeria all plants "were located in the same geographic region and thus enjoyed the same advantage in quantity and quality of raw material and labour supply, all sold their product to the same market and all used identical machinery with similar plant layouts".[22] Yet the unit labour requirements of the most efficient firm were substantially less than half those of the last efficient, and the output per machine was nearly four times.

Myth No. 4—A hoe is a hoe is a hoe. This myth can perhaps best be explained by an illustration. A common hoe used by rice paddy farmers in Sri Lanka would seem a fairly straightforward standard item, subject to substantial production economies of scale. Yet there are at least 13 different designs of hoes currently in use each one suited for a particular task and/or soil condition.[23] It may very well be feasible to produce two or three standard hoes in large quantities at an apparent saving in unit cost.[24] Yet against this apparent saving, must be offsct the lower efficiency of the farmer by having to use the rong hoe but the only one that is now avaiable. He can now prepare less ground, he does more damage while weeding, it takes him longer to harvest, etc. Because of the relatively minor cost of tools in the over-all farm budget, even quite a small efficiency loss can more than offset a substantial savings in unit tool costs.

Similarly, in several countries, the introduction of modern mechanical spinning facilities has led to the production of wool yarn much finer than the hand-spun variety...too fine in fact to be used by the local carpet industry, which was initially intended as a major user of the factories output.[25] There are certainly many other instances in which standardisation in order to exploit the anticipated production economies of scale has actually inflicated significant but hidden costs on the users of the discontinued items.[26]

Myth No. 5—Modern technology, once operational is risk-neutral. In its simplest form, this myth assumes that once the "bugs" are worked out, the "modern" technology will perform with approximately the same reliability as that which it replaces; and, there is no need therefore, for a special recalculation of the risk premium to provide for failure. Any risk premium is a function of two variables, the likelihood of things going badly and the resulting costs if this happens. But a modern technology "transplant" into a different economic environment normally increases both these variables, sometimes quite substantially. In the first place, it typically leads to a major increase in external dependence upon the supply of items over which there is virtually no control. Imported spare parts, semi-processed raw materials, highly specialised repair and maintenance services, electricity and/or diesel fuel are now all indispensable to the operations of the new machine. If the supply of any one of these inputs is interrupted, for whatever reason, the whole operation stops. And the manager of the loeal co-operative or common facility centre or whoever is directly responsible for the utilisation of the machine is usually relatively helpless when such a supply breakdown occurs. Secondly, modern technology generally demands a substantial increase of specialisation within an industry. This in turn implies an increase in internal

22. P. Kilby, op. cit., p. 305.

23. P. Nagawela, Les petites industries en Sri Lanka, les realisations des "Divisional Development Councils" (DDC); Ph.D. thesis submitted to 1' University des Sciences sociales de Grenoble, France, June 1977. He also identifies 4 different types of Sickles, forks, 5 spades, 6 rakes and 21 knives all currently being manufactured in small blacksmith co-operatives.

24. I am assuming, of course that a proper social cost/benefit appraisal is made, which may be a very unrealistic assumption.

25. From reports on ILO technical co-operation projects. In one case, the weavers actually had to respin this fine yarn into a two-ply yarn in order to make it heavy enough for carpet weaving.

26. The two illustrations refer to intermediate goods used in further production activity. An analogous effect occurs concerning consumer goods. Although it is sometimes argued that much of the differentiation among similar consumer products is illusory, it would certainly be presumptuous to assume that consumers do not arrive any real benefits from this differentation.

dependence. Consequently, a breakdown of any one operation or of the supply of any one input imposes a stoppage or at least a slowdown on all the other stages. This specialisation may in some circumstances also imply less flexibility to meet changing patterns and/or levels of demand. Finally, while such technological "transplants" may result in less unit costs per output the total fixed investment will almost always increase. This fixed investment will have to be amortised regardless of whether anything is actually produced, and chances are usually fairly good that a significant portion of this amortisation will have to be in foreign exchange.

This phenomenon of increasing risk is most relevant to large centripetal technological changes which require significant organisational "rationalisation" for their exploitation. But it can also apply to centrifugal technological innovations. Consider for example the case of electrically-powered hand tools which the village carpenter purchases following the advice of the small business extension agent. But he only uses them for a small fraction of their useful life because no hardware supplier in his vicinity stocks the cutting edges which need to be periodically replaced.[27]

All these myths are easily recognised when isolated and spelled out explicitly. But that rarely happens. For a variety of reasons (political pressure to take highly visible dramatic action, bureaucratic-vested interests, aid-agency biases, sales efforts by equipment exporters) they remain hidden in the framework of presumptions within which specific investment decisions are made. They all make the large-scale, high-capacity machine look more efficient than it actually is. As such, they collectively lead a de facto technology policy which prejudices development efforts against the small producer utilising local methods and resources. And this prejudice operates regardless of whether the relative prices of capital and labour reflect their scarcity values.

C. A workable concept of appropriate technology for small-scale industry

So much for why appropriate technology requires active promotion and so much for the prejudices under which it labours. Let us now try to outline a workable concept of appropriate technology within the context of small-enterprise promotion.

One way to approach this question is from the negative side, by considering the characteristics which tend to *disqualify* a specific technological innovation. Four come to mind. Firstly, any innovation which causes a major shift in the ratio of capital to labour inputs per unit of output can be considered relatively capital-intensive. Secondly, any innovation which requires for its exploitation a scale of operations or organisation radically different from that scale current among other units within the local economy (but not necessarily current within the same industry) can be expected to cause diseconomies of scale in its over-all managment, its internal organisations and operations and in its relationship with the rest of the economy (e.g. purchases, marketing, transport). Thirdly, the risks associated with the innovation, both in terms of controlling the factors required for implementing the innovation successfully and also in terms of absorbing the costs implied in the event of failure, must be within that range which the innovating entrepreneur can bear. Finally, to the extent that technological innovation results in (or reinforces market dominance, it can be expected to lead to organisational inefficiency, a misallocation of resources and "excessive" profits on the part of the innovating enterprise.

Turning these disqualifying characteristics around, we can state the general rule that the appropriate technological innovation is the one which (a) does not

27. So far we have talked about the increasing risk factor and its tendency to be overlooked only in the context of a developing country. But it is also valid for technological change in a development economy as well. See for example H.S. Robinson; "Loss risks in large integrated chemical plants" and "Is operating process safety keeping pace with changing technology?", two speeches cited in John M. Blair, op. cit., pp. 93-94. See also C.G. Burck's account of the technological problems of the ultra-modern Bay Area Rapid Transit System "What we can learn from BAT'S Misadventures"; Fortune Magazine, July 1975 (Time Inc,; New York), p. 104 et seq. "BART'S fundamental problems...arose from a profound underestimation of the difficulties that were boundt o occur when new techology was applied to an old form of transportation." p. 105.

radically change the ratio of unit capital to labour costs of the finished product: (b) which does not require a major change in size or structure from existing enterprises; (c) which involves a financial risk within the range bearable by the local enterpreneur: and (d) which increases or enhances the competitive vigour of the economy. In principal, *any* innovation which meets these criteria can be considered appropriate. We can take this concept a bit further and say that technological change which represents a marginal improvement over traditional methods will almost certainly meet this test. These should perhaps receive the planner's first priority.[28]

So far this considers technological change only within the context of single specific innovations. For the small entrepreneur, technological innovation is a sporadic, ad hoc event. For the planner, on the other hand, technological change is much more a continuing process. Individual innovations complement (hopefully) each other to create a dynamic gradual technological evolution across a broad front. The planner, therefore, may leave the initiative for specific innovations to the people who will have to make them work (i.e the entrepreneur), but he is still very much concerned that such technological innovations do in fact occur, that they occur over a wide front, and that they aggregate into a broadly based technological evolution of the economy as a whole. This broad dispersion of technological innovation is particularly significant to small-scale industry promotion since it is a *sine qua non* if individual isolated innovation is not to lead to market dominance by the one or two entrepreneurs (large or small) fortunate and/or crafty enough to have innovated first.

From the above, we can conclude that an appropriate technology policy for small enterprise promotion will have two basic elements. Firstly, it will ensure that technological change in a general sense does in fact occur and that it takes place on as broad a front possible. Secondly, it will ensure that specific innovations by individual small entrepreneurs conform to the four characteristics mentioned earlier. Within these two objectives, there should normally be a decided preference for marginal improvements of existing techniques over large technological jumps.

D. Promoting appropriate technology for small firms

Clearly specific efforts to promote appropriate technology for small firms will depend upon the unique circumstances of each country. From the earlier discussion it is also clear that appropriate teehnology is as much a point of view, a perspective from which to view specific innovations, as it is a particular production technique. In the case of small enterprise promotion, the primary decision maker is the small enterpreneur himself. This is as it should be since he is normally the one who will both bear the primary responsibility for making the innovation productive and suffer most of the consequences if it is not. He is also in the best position to judge before the fact how really feasible a proposed innovation actually is. This leaves three broad levels of action open to the public authority : (a) creating favourable general conditions : (b) encouraging the demand; and (c) stimulating the supply.

(i) *Creating favourable general conditions*

This is largely a question of broad macro-economic policies. Three such broad policies are of particular relevance to technological change. Firstly, the relative prices of capital, labour and products should reflect their economic scarcity. The general consensus among informed observers is that the small-scale sector faces by and large, effective prices for capital and labour which do reflect their respective scarcity. This is much less so the case, however, concerning products. Overt price discrimination is probably less frequent than covert forms of discrimination such as high "discount" because of allegedly greater variations in product quality or relatively expensive (albeit "refundable") costs for tender documents for bidding on public purchases. Perhaps the most significant commodity pricing bias is the overvaluing of local currency, which

28. Regarding the preference for marginal improvements on existing techniques, it may be worth noting an often overlooked lesson from developed countries. "It is axiomatic among aerospace engineers that if more than 10 per cent of a project is new technology, it's going to run into a lot of problems.,' (C.G. Burck, ibid., p. 105.

makes foreign goods unrealistically cheap domestically and local goods unnecessarily dear in the export market.

The second broad area for encouraging appropriate technology is in ensuring a *stable* economic and social enyironment that encourages private small-scale initiative. As a general rule, the fewer uncertainties about his environment a potential small-scale investor must ponder, the more confident and willing he will be to make such an investment. The most basic condition for this is obviously the maintenance of civil order. Part and parcel of this is a public administration which both is and is seen to be objective and even-handed and efficient. Basic policies about, say, the role of the private sector certainly can and do change. But the few and smaller such changes are, and the more precise these policies are, the better.

Finally, infrastructure is critical to technology. As we have already seen, technological upgrading normally means an increasing dependence of the small enterprise on the supply of factors outside its control. The supply of electricity, the maintenance of roads over which raw materials and/or finished products are shipped, parcel post for spare parts, telephone and telegraph for communications, are all government services of paramount importance to the small producer. As in the case of the policy environment, the issue is not that any particular service reach a high level but rather that all achieve a minimum level of coverage and reliability.

(ii) *Encouraging the demand*

Encouraging the demand for appropriate technology involves making it at least competitive and preferably more profitable than its inappropriate alternative. This also implies ensuring that those who want to innovate have the means to do so.

One obvious step is to make the expensive imported equipment pay its full social cost. In an environment of unsubsidised capital, competitive labour markets and free exchange rate determination, the private cost of the imported machine is probably an acceptable surrogate for its not social costs. But in more common circumstances recourse should be had to other more direct measures, such as a tax on imported machinery and equipment.

Several areas of initiatives are also open. Information about the range of technical alternatives is certainly an important one. Several media (newsletters, technical memoranda, technical referral networks) would be appropriate. It is also important that such information-oriented initiatives be aimed not only at the small entrepreneur, but also at those with whom he does business, such as his banker.

Lack of access to capital at virtually and price is a common complaint of very small entrepreneurs. Thus another area for initiative may be increasing the supply of capital available to the very small entrepreneurs. Two pitfalls, however, should be avoided. Firstly, while there may be a case for making more capital available, there is no case for subsidising this availability. Many small loans cost more to set up and administer than one or two larger loans; and they should be, expected, therefore, to pay accordingly. (There should also be, of course, creativity and flexibility in channelling this capital efficiently, e.g. credit unions and collective guarantees.) The second caution concerns earmarking capital for fixed investments. Bankers and creditors in general often prefer to see their money backed up by some "hard", tangible assets which they can claim if things go sour. While there may be some logic in this from their perspective, earmarking lendable funds for investment in fixed assets tends to encourage capital-intensive production.

The content of vocational training programmes is another area open to initiatives. In many instances, the de facto definition of a skilled worker is the ability to operate a modern machine. The more sophisticated the machine, by implication the more skilled is its operator. The more vocational training programmes emphasise this machine-oriented training, the more they encourage the small and the large entrepreneur alike to lean towards capital-intensive production methods. What is needed are training programmes which develop skill and versatility with hand tools and simple machines which the trainees can expect to find in actual use after they leave the training centre.

So far, we have concentrated on the economic motives of our agent of change, the small entrepreneur.

But while he may be economically rational, pecuniary rewards will probably not satiate his appetites. We have already seen how "engineering man" tends to crowd out "economic man", particularly as economic exigencies become less demanding. Perhaps more efforts could be usefully devoted to enhancing the social status of the small innovator with the community. Some of the information media mentioned above might also be effective for this purpose.

(iii) *Increasing the supply*

On this side of an appropriate technology policy, two tandem directions for public initiative are in order. Firstly, the range of feasible alternatives open to the small entrepreneur should be as wide and with as few gaps as possible. A number of mechanisms can be employed. Basic R and D into alternative techniques, prototype production and the establishment of model units; all have their role to play. Each mechanism, however, needs to be closely associated with a system both for disseminating its findings to the intended final users and also for getting "feed-back" from these users concerning their usefulness. Subcontracting, in the sense of a large parent firm (often expatriate) surrounded by a series of small satellite firms supplying it with particular inputs, is also an effective means of exposing smaller firms to modern managerial techniques.

The second direction concerns the encouragement of a healthy local capital goods industry. This is clearly central to the efficient operations of large as well as Small firms, for it supplies spare parts and maintenance and repair services essential to all sectors of the economy. It is also noteworthy that the manufacture of machinery and equipment is itself a relatively labour-intensive industry in which small firms have a distinct competitive advantage. Associated with a rigorous capital goods industry may also be some sort of legal protection so that inventiveness is advantageous not only for the user but also for the inventor.

E. The special problems of artistic handicrafts and cottage producers

Earlier we stated that the technological dilemma is often less significant than assumed. There are still circumstances, however, where even a minimal amount of technological upgrading runs into major organisational difficulties. This is particularly true for artistic handicrafts and for cottage industry. In the case of artistic handicrafts, the infinite variations of design that can only be achieved by skilled handwork are a major attribute of the finished products. Technological change which reduces the scope for product differentiation will in effect undermine the craftsman's market competitiveness. Thus the principal areas for significant technological change are in the peripheral activities such as preparing raw materials and/or finishing of end products. But the firm economies of scale for these peripheral activities are usually radically different from those of the core activity (carving, handweaving knitting, etc.) and there is an economic tension between the positive scale economies of the peripheral activities and the negative scale economies of the core activity.

Concerning cottage producers the situation is slightly different. Here the key economic factor is the utilisation of a resource which would otherwise be wasted or is available in only very small scattered amounts. In most cases this resource is labour,...idle periods during the agriculture cycle, older people who are also looking after children, women also tending a market stall. In these situations, technological innovations to improve productivity are desirable only so long as they do not conflict with the performance of the dominant activity Care should be taken to consider not only the dominant activity of the individual but also of the economic "group" of which he/she is a part.[29] In other situations where the limited resource is a raw material only available intermittently or in small quantities, technological upgrading is unlikely to yield significant economic benefits until there is an increase in the physical supply of the "bottlenecked" raw material.

For both the artistic craftsman and the cottage producer, therefore, common facilities services play an important technological role and the public authority can normally take a more direct part. Most common

29. For the importance of this economic "group" concept, see J. Mouly, "Some remarks on the concepts of employment, underemployment and unemployment"; *International Labour Review*; February 1972, ILO, Geneva, 1972), Vol. 105, No. 2; pp. 155 to 160.

facilities fall into one of three types. The first allows the craftsman access for short periods to tools and equipment which his scale of operations cannot justify owning outright, He either takes the tool/machine to his workplace or brings his work to the machine, but in either case he maintains direct control both over the immediate activity and also over the over-all production process. In the second type, the common facility carries out for the craftsman, but at his initiative, the production activity involved. For example a carpenter may have wood which he had dragged out of the forest kiln-dried and which he then takes off to his own workplace for making up into furniture. The common facility centre acts as a sort of subcontractor to the artisan/enterpreneur. In the third category, the common facility centre itself acts as the entrepreneur, at least for this step of the production process, and operates in effect as a supplier of a semi-processed input to the artisan/cottage producer.

Obviously, the choice of organisational model will depend upon immediate circumstances. Yet regardless of how the service is organised, there are certain features of all three which affect the choice of technology. Firstly, material handling problems become critical. The commodity must be easily transportable and durable enough to support the several physical movings involved. Secondly, it should be easily quantified and measured to facilitate the several changes of responsibility for its safekeeping. It should be of a fairly standard nature so that its production does not have to be intimately synchronised with the manufacture of the finished product. Finally, there should be significant enough economies of scale to justify the extra costs implied in organising its provision along common facility lines.

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Building Productivity Culture

G. SARAN

Even with the often preceived macro-level necessity of productivity as the means of expediting economic growth—a key for early eradication of poverty, one finds relatively very little in terms of an organised effort translating it into action. Similar to what other societies have experienced in our country too, it is not uncommon to see a vast majority of people still considering productivity as someone else's concern. This paper focusses on the need for building a deliberate well-organised effort for management of productivity in the entire organised sector and otherwise.

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Productivity Year : 1982—A National Overview

The year 1982 heralded our respected Prime Minister's call to observe it as the 'Productivity Year'. Activitywise initial months saw some Government meetings discussing the subject. Prominent among them was the one in which the Prime Minister spoke in a Secretarial level meet emphasising the essentiality of enhancing productivity in all spheres of economic life. Few articles and notes in the newspapers followed. Government's continuing concern was brought to the fore by Finance as well as Industry Ministries of the Government. In one of Hon'ble Minister very first meets—an address to a gathering of NPC, he brought out lucidly specific directions for enhancing productivity. The National Productivity Council did engage itself into developing organisational processes and launched a series of programmes and made announcements for industrywise awards. A few Public Sector Organisations created separate groups to evolve/operate the 'PRODUCTIVITY MANAGEMENT' function, yet some others conducted well-organised studies.

Private institutions conducted similar symposia, workshops and seminars to discuss various aspects of productivity. Bodies like Times Research Foundation convened an essay competition on productivity and also a workshop on Price Controls in Indian Economy.

In the middle of the year one could 'simultaneously see newspaper reports linking the productivity call with

the long drawn textile strike. Many journalists and some other institutions apprehended now and then that 1982 may end up as the least productive year.

In the traditional way, the year's end saw a symposium concluding that the objective of the Productivity Year has been achieved and that people have become aware about productivity.

Any serious student of Management, Economics or Productivity would be curious to know what and how much has been really achieved by organisations in Government and Industry; Public Institutions like Schools, Hospitals or the Municipality; in the Infrastructure services and business in Public or private Sector, to enable furtherance of this cause.

While a well-quantified conclusion would call for conduct of detailed surveys/research, one could observe certain emerging patterns out of the debate that got/generated during the year and the cognizable efforts made by certain organisations in terms of productivity targets. In the process the later organisations also generated considerable productivity consiousness and new directions for introducing a productivity work culture.

Unaware of actual efforts, may critics questioned the utility of the large number of academic debate and such dedication to productivity at the verbal level. Giving them the benefit of doubt, it may be worth pointing out to them that injecting concern for Productivity amongst the economic and business leaders of the country is a must, irrespective of the cost incurred—for the simple reason that productivity is a means of survival and cannot be warded off as a fad. The fact that it is permeating into the national psyche stands confirmed by the fact that organisations like BPE, NPC, AIMA, IIPA, ASSOCHAM are discussing various aspects of PRODUCTIVITY more rigoursly in 1983 than during the Productivity Year. Such manifestation, if it be true could be related to environmental cause and effect phenomenon impacting the minds of economy leaders. The causes can be classified as :

* Pressure on resources
* Growing realisation and emphasis on minimum social/welfare needs of the large population
* Statistical alarms—significant among them being the deteriorating capital output ratio.

Judging the notes and reports one can see three distinct emerging segments of thinking :

Government, and the Government Influenced/Directed Segment

Though much has been desired by the Prime Minister from a good number of Government/Public Sector organisations, the initative and achievements of many others stand recognised for their having generated new directions. The recently held 'Public Sector Undertakings Productivity Workshop' is an excellent example. In this a large number of public sector organisations got together to discuss the theme "Consolidating Experiences for Organising Productivity Management".

The Critical Segment

While the above group looked searching for answers, many Societies and Private Bodies continued to find fault with the Government, the Bureaucracy and the national policies highlighting them as the key to the doors to productivity improvement. Very little appears to have been talked about the possibilities of what they can do to initiate and contribute to the country's economic and social development as responsible corporate or social organisations. It has been indeed an exception to read Dr. Freddie Mehta, Director, Tata Sons, who, while being critical of holding of too many seminars and symposia on productivity exhorted the private sector of its responsibilities. In introducing the paper presented to ASSOCHAM in March 1983, he quotes Great Britain's decade 1945-55, when tremendous efforts were made to study productivity practices. He cites now innumerable symposia, workshops and conferences were held, reports generated and disseminated. In effect, however, as per Dr. Mehta, the productivity in Great Britain declined during this period. After his subsequent analysis in the paper of the current national scenario, Dr. Mehta raises certain basic questions to the private industry like "the private sector ought to take hard look at itself in the context of wasteful use of oil and raw materials". He asks "how many of them could genuinely claim R & D achievements" or "what they did to use the by products." The private

sector, he said, "was found of saying that skill formation was as important as capital formation...But how many took up specific programmes for upgrading skills of their workers," he questioned. (Mehta, March 1983.)

The Unconcerned Segment

Last and perhaps the largest group is the one which is unaffected and untouched by any talk of productivity. To them it is an alien concept and perceivably not possible of application in our environment.

Overall, thus, we have as a Society, certainly not adequately responded to the national call. We should, therefore, continue to make further attempts to understand the implications and compulsions of productivity.

Response Time Lag

Examining the international scenario one can draw some solace that we are not alone in this response-time-lag to a call for economic survival. Britain, U.S. and Europeans have all gone through this. The example of United States is perhaps the most current and relevant. Only a few decades ago we all considered America as the highest Temple of Learning as regards Productivity. But lately their own Temple seems to have shifted to Japan and now South Korea. Seemingly, it would appear that societies tend to develop an inertia tied up with the internal system. Some have built-in early warning systems and course-correction features whereas others take longer time to react. Respond we all must! If we have to survive. To quote Dr. F.A. Mehta again where he described that Japan itself was slipping down in the later part of the decade 1960s and the society was revolting against both productivity and growth.

> "It was the OPEC which has again brought the new Japanese generation back to the path of maximising growth and productivity. As some Japanese sociologists privately say: Japanese society owes a debt of gratitude to OPEC for restoring to it the solid virtues of its neo-confucious culture."

This raises some basic issues about the compulsions and concern generated in India due to national and international socio-economic pressures. Since the response has not been large enough, one can say that either the intensity of the forces demanding change are inadequate or our perception mechanism is too slow to react to the environment.

Profit : The Main Drawing Force

But before we go into identifying the reasons for slow responses, it will be appropriate to see the 'Profits', 'Price' and 'Productivity' relationship in a rationalised model form. Based on the classic definition of productivity i.e.

$\frac{\text{Output}}{\text{Input}}$ such a rationale correlating profit dynamics is attempted in the following figure 1 :

$$\text{PRODUCTIVITY} = \frac{\text{PRODUCT as output}}{\text{RESOURCE as input}}$$

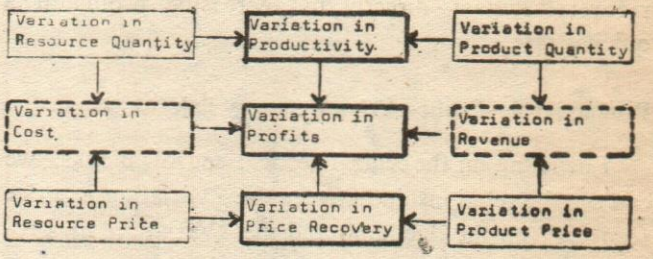

Fig. 1

$$\text{PRICE RECOVERY} = \frac{\text{PRODUCT Price}}{\text{RESOURCE Price}}$$

Physical Quantity Ratio : Productivity

In developing this model the central set of horizontal blocks have been drawn to represent: 'how' in the Conventional System 'Variation in Profit' is achieved through 'Variation in Revenue' and the corresponding 'Variation in Cost'. The top set of blocks exhibits the corresponding physical-quantities' dynamics i.e. of input (resource) and output (product). In fact 'Variation in Productivity', in its elementary sense is derived from the variation of ratio of these two components i.e. 'Variation in Product Quantity' and 'Variation in Resource Quantity'.

In the national context any increase in the ratio between product quantity and resource quantity, which results in a positive variation in productivity would alone accelerate the rate of growth of GNP.

Price Ratio : Price Recovery

To study the parallel price dynamics mechanism let us look at the bottomline set of blocks. It will be appreciated that the price of input and output which impact the 'revenue' and also the 'cost' flows through to 'Variation in resource price' and corresponding 'Variation in product price'. Analogous to the productivity ratio, thus one can visualise a 'price recovery' relationship at any point of time. When 'product price' increases at a faster rate then 'resource price' the result is "Price over recovery." Other factors remaining constant, "Price over recovery" will have correspondingly direct increases in profits. On the contrary "Price under recovery" occurs when resource prices increase at a faster rate than product prices. All other factors remaining constant "Price under recovery" impacts directly in decreasing profits at a quicker rate.

Productivity—Profit—Price Recovery link

Focussing on the central vertical set of blocks, we can see the relationship between the "Variation in price recovery" on the one hand and the "Variation in Productivity" on the other as the two sides of a sea-saw. This puts the Productivity-Profit-Price recovery relationship in the correct perspective in contrast to the normal profit picture as the difference between the revenue and the cost shown horizontally in the central block set.

The Easier Option

Gradual upward price regulation of items required to meet minimnm human needs like agricultural products and minimum wages is obvious in any developing economy. Consequent upward variation in 'Resource Prices' for industry inputs implies choosing between raising PRODUCTIVITY or PRICE RECOVERY as a means to even sustain the same level of profits. While the former calls for better management of resources the later focusses on probing the market for obtaining an increase in product price. Here again, though in the case of Government controlled business, prices are subjected to regulation; the Private business remains free to a large extent. They have, a preferential door open to play with—the market forces. Our market being sheltered by the Government which is an essential feature of its policy to protect the economy is thus favourably availed by Private business to its advantage. This is obvious from the following emerging business behaviour patterns in a large number of cases barring some well-managed organisations, who are also subjected to price control :

*Preference to trading where material changes hands many times before it is finally worked upon;

*Concentration of effort to buy and trade licencing capacities; and

*Applying of energies to maximise gains through 'price recovery' by pushing the product prices in a famished market.

It is indeed a tribute to the Indian society which has continued to absorb the increasing price burden without much reaction as indicated by the absence of organised consumer reaction even in urban areas. It is still bigger a tribute to our Government which has contained the inflationary pressure through appropriate monetary and fiscal management even when productivity levels are low, more so when the developed economies are moving through a state of economic depression.

Productivity Further Analysed

In further developing the rationale for GNP growth which has a direct relationship with the productivity incremental, two components emerge for sharp scrutiny. These relate productivity to 'Variation in Capacity Utilisation' and 'Variation in Efficiency and Effectiveness' as shown in figure 2.

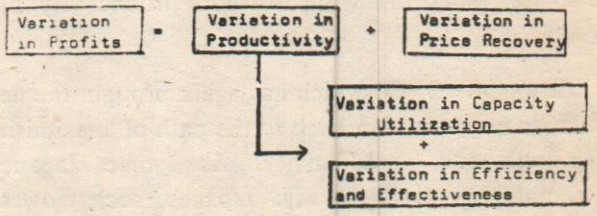

Fig. 2

Variation in Capacity Utilisation'

Capacity considerations should really be viewed under two specific scenarios. One dealing with the

resource-set which the Economy/business currently holds and the other related to the possible 'resource-set' of the future. The latter is understandably created as a part of the corporate planning process for future investments.

* Current 'Resource-Set'

The term 'capacity', (keeping away the adjunct 'utilisation' for the present) has boggled many a mind. Any number of studies and references could be recalled. All types of definitions and figures are mentioned as currently seen in the newspapers referred in reports like that of COPU, references quoted about the abuse of the licencing and exceeding of production by monopoly houses beyond the limits. To this picture the titles Installed Capacity', 'DPR Capacity' and Achievable Capacity' (often related to process industries), lend a generalised supporting backdrop. It is not uncommon to see Business/Industry. Institutions and Monitoring Bodies using any of these titles as a datum for referencing and at times reporting much more than 100% capacity realisation or a very small percentage depending upon the situational scenario. On the contrary the major national objective as mentioned by the Hon'ble Union Finance Minister, Mr Pranab Mukherjee in his recent talk at a seminar on Management of Economic Development—New Horizons (IIPA), spoke about the ensuing Government policy in a different direction. To quote "*The major objective of Government policy in the coming years would be to increase productivity of investments made so far to make them yield adequate returns in the form of higher production and generate resources for further investment.*" If this is to be translated into action, which we must for survival, the term capacity relating to existing resources would have to be reviewed much more critically. Goals for optimisation would then focus on areas like :

— Achievement of maximum possible, from the current available man-machine set after application of all available management tools and techniques that produce synergistic effect.

— Lifting the level of capacity over the one referred above by incorporation of minor resources, synthesising therein the method of line balancing. This then becomes relevant to modernisation with minimal expenditure.

— Basic level technology upgradation which can be brought about by greater involvement of people in innovative process. This would imply enhancement through acceleration of technological processes through priority spending on innovation for capacity improvement.

— Application oriented R & D and its diffusion. This too appropriately planned would lead to systematic and optimised growth of capacities.

* Future Resource-Set

With competition becoming more and more tough, advanced countries and international business is realising the void in corporate planning relevant to productivity in future investments. Roy Hill writing in the October 1980 International Management issue, referring to a Chicago Symposium writes "Here are some of the management policies : decisions and mistakes which can seriously affect productivity :

— Too little attention and preference given by Corporate Planners to segments of the business which offer unusual productivity gains rather than those where the productivity potential is marginal.

— Insufficient thought devoted to the degree and longivity of productivity improvement as a factor in capital investment decisions. Although in the short run, corporate earnings can be improved by acquisitions based on profit potential, in the long run they may well be better served by acquisitions which contribute to productivity."

(Hill, International Management 1980,)

In this connection a reference from BHEL, having taken a lead in introducing productivity management is also relevant. In directing the preparation of a paper for discussion in the Joint Committee of the BHEL's Productivity Programme 1982 under the title "An Approach Paper", Chairman BHEL, Mr. K.L. Puri emphasises on building close relationship with the

planning processes as a long term strategy for productivity improvement. To quote para 6 of the paper :

" 6. Long Term Strategy

For effecting long term productivity improvement a close relationship of the planning processes employed in development of operating programmes with corporate strategies extending into marketing is essential. A good advance order book with stable markets provides the right base for decisions in favour of standardisation, product batching, and application of other innovative features. On the other hand maintaining of a close link between opaerations planning and corporate growth can bring back qualitative and quantitative information regarding future capital investment decisions."

(BHEL Corporate Study Group papers 1982).

The above features highlight, how increasing capacity utilization can be optimally matched with investments extending from current to future assets if productivity is made the pivotal point for capacity growth.

'Variation in Efficiency and Effectiveness'

Any number of Research, Survey and Study documents from the developed coutries confirm the vagueness with which "PRODUCTIVITY" is comprehended by people and organisations at large. Most people associate the concept of productivity with production and manufacturing because that is where resources manifest themselves in a cognizable and tangible form. Historically, this is the area which has been prominently subjected to measurement and efficiency considerations. The stress thus remained mainly on improving the 'efficient' use of inputs like man, materials, maehines. That is how perhaps the classical definition of productivity got framed. Later developments are, however, taking PRODUCTIVITY to macro Business situations and Public Services. Further it is being stressed that output should be considered in terms of 'Performance Achievements' with 'Effectiveness' as the core consideration.

Productivity, The End Result Variable

With consensus developing towards limitations of global resurces and nations fighting to retain their commercial top competitive status on the one hand and societal and human needs getting greater emphasis on the other, Productivity is finding new definitions. Out of the many ratios the one emerging from Norwegian Productivity Institute is perhaps the most appropriate.

$$\text{PRODUCTIVITY} = \frac{\text{Satisfaction of Human Needs}}{\text{Economic Sacrifices}}$$

Keeping these emerging concepts of productivity in view one has to visualise the challenges which any productivity effort throws up. It must permeate all human activity and through the efficiency-effectiveness contribution ultimately create synergistic effects in the man-machine system and maximise human satisfaction. A chronological study of the nature and type of developments in this field and institutions that have sprung up in the countries with lead economies confirms this trend. There is a cognizable shift from study of the shop floor output/input ratio on to white-collar areas, to the impact of organisational outputs on society and ecology and last but not the least on the quality of work life. Efficiency and effectiveness are thus to be seen as significant components of 'Productivity' as an end result variable.

An Introspection

Even with the often perceived macro-level necessity of productivity as the means of expediting economic growth—a key for early eradication of poverty, one finds relatively very little in terms of an organised effort for translating it into action. Similar to what other societies have experienced in our country too, it is not uncommon to see a vast majority of people still considering productivity as someone else's concern.

This for building a deliberate well-organised effort for management of productivity in the entire organised sector, to begin with. This should objectively focus on micro-level activity and attempt to stop waste of all forms on the one hand and find ways and means to infuse innovation to make the management of resources more efficient for obtaining effective outputs on the other. Action on these aspects needs to be organised on priority with involvement of the highest levels to enable crossing the humps of a debt trap and the poverty cycle, currently haunting the economists.

The Debt Trap

To understand the implications, even a layman will appreciate that unless we help the growth of real GNP at an accelerated pace from the available capacities by making use of productivity methods, the Government will find it difficult to contain the pressure of price rise and inflation through monetary and fiscal management for long. Unless the physical output rates grow faster than what we have achieved, we may find it hard to justify the growing capital output ratio index. The deteriorating current figure of 6 : 1 is highlighted time and again and should be a cause of growing concern. Such pressure on capital requirement for maintaining minimum levels of growth can be internally—met only upto a point through savings and fiscal policy adjustments. As some economists observe, if the growth rate of capital formation is not substantially increased through recycling by better usage of available resources, the country could be sucked into the international debt trap.

The Poverty Cycle

Any reference to growth of GNP, poverty and standard of living remains incomplete without reference to population. The latter is a very strong component whenever reference to other aspects of economic growth are discussed. Added to this is the right stress of the Government in maintaining focus of economic growth on equity for the entire population. In a recent reference Dr. M.B. Athreya while talking to the Asian Directors Conference organised by AIMA at Kathmandu, spoke about some relevant relationships in the following table :

Average growth of GNP	*VI Plan Targets*	*Expected Rates*	*Potentially possible Achievement*
Growth rate	5.2%	4.5%	6.0%
Population growth	1.8%	2.1%	1.5%
Per Capita growth rate	3.4%	2.4%	4.5%

It will be seen that the average growth rate of GNP targetted in the VI Plan @ 5.2% and a population growth rate of 1.8% will give a per capita growth of 3.4%. As against this the expecied rates are 4.5%, 2.1% and 2.4%. It is computed that at this low 2.4% per capita growth rate it will take nearly 60 years to provide the average minimum food requirement of 800 calories to the growing population (normal requirement being 2400 calories). On the contrary if the GNP potential achievements can be made feasible by raising the rates to 6% and the population growth brought down to 1.5% the per capita growth of GNP can be raised to 4.5%. This can reduce the span of providing the minimal food requirement from 60 years to 15 years.

Productivity Needs a Unification of Concern & a Deliberate Programme

If ever we may think of catching up with the industrially developed countries whose technological advancement is currently moving in geometrical progression, we shall have to give up the critical stance and join hands to build on our little successes in harnessing productivity methodology. We can ill-afford to leave the potentially possible acceleration of the GNP growth rate, by not putting our limited resources to more intelligent use. This is essential not only to compete with the affluent countries but to feed the millions.

We cannot live with this thought that productivity is only the Government's possibility. What is required is a deliberate national productivity programme aimed at creating a productivity culture in which individuals, groups, organisations, at all levels drawn from all walks of life will find associating with the productivity effort alone will get them any benefits.

REFERENCES

Roy Hill	October	1980	Can Sagging Productivity be Reviewed (International Management magazine)
Corporate Study Group	April	1982	An Approach paper (BHEL Productivity Papers)
Dr. F.A. Mehta	March	1983	Productivity in Indian Industry (Talk at ASSOCHAM, Calcutta)

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Productivity
1984, XXV, I, 75-85

Productivity: A Human Resource Perspective

D.M. PESTONJEE

Productivity is a problem on which research and theoretical opinions abound. In the present paper an attempt is made to highlight the human resource perspective. More specifically, the attempt is directed to explore the relationship between industrial output or productivity and the personality dimensions of operators.

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The author thanks Ms. Vidya Karan for her academic assistance in the preparation of this paper.

Productivity is the major goal of all organizations. It is crucial to the survival of an organization' thus Management attempts to reach optimum levels of productivity by using various methods such as financial and non-financial incentives, changing supervisory methods to more democratic and participatory styles or both, and sometimes by using coercive tactics.

The term, productivity connotes different meanings to experts from different disciplines. To macro-economists it is an indice aggregated at the level of the economy as a whole. To micro-economists and macro oriented management theorists, productivity is specific to industrial firms and organizations. Organizational psychologists, on the other hand' tend to focus on the the productivity of individuals and small groups assuming that increases in performance of these units, enhance the performance of the organization as a whole.

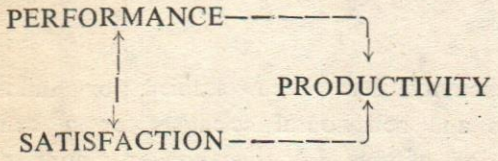
Productivtty has been studied by industrial engineers and behavioural scientists for a considerable period of time. Initially a greater emphasis was placed on machinery because productivity was considered synonymous with machine outputs. The human element was considered an appendage to the machine. Gradually, with the introduction of labour laws there was a shift in emphasis and it was recognized that the human element was as important an ingredient in organizational effectiveness as the technical element was, and that no output is possible without willing cooperation of this element. The *human engineering*

movement was born out of such a reslisation. Machines now came to be designed to suit and adjust to the operator requirements. This gave birth to the 'man-machine system' concept.

Productivity, Performance and Output

The terms productivity and performance have been used interchangeably by psychologists to refer to variables which include output, quality and turnover. However, at the conceptual level a distinction needs to be made between productivity, performance and output. Productivity is the theoretical maximum which a man-machine system is capable of producing. Generally output or performance is below this theoretical maximum due to the inability of either of the two elements to operate at the maximum. Sometimes the goals are set in such a way that the output surpasses the target indicating that the theoretical maximum or productivity has not been properly identified. Another distinction is that productivity is not an individual variable: rather, it is the end result of an individual's job performance and so is measured in terms of non-behavioural criteria such as monetary volume of sales or other organizational outputs such as monetary volume of sales or other organizational outputs such as profits. Top performance, on the other hand is a causal variable and should be conceived as an individual psychological veriable (Kanungo, 1982).

In general, productivity can be conceptualized as the final outcome of the interaction between performance and satisfication :



Job satisfaction is an important element in productivity. Job satisfiaction is "the pleasurable emotional state resulting from the appraisal of one's job as achieving or facilitating the achievement of one's job values" (Locke 1969). However, the relationship between job performance and productivity is evident only when there is a correspondence between job performance and specific behaviours required on the job that directly result in organizational outputs. However, generally the criteria of job performance are determined at the organizational level whereas specific job activities are determined at the individual level and they may not correspond to each other. For example, job performance of a sales person may be measured through rankings as opposed to actual number of customers contacted, persuasion etc., and in this case job performance rankings may not rightly corrolate with sales productivity.

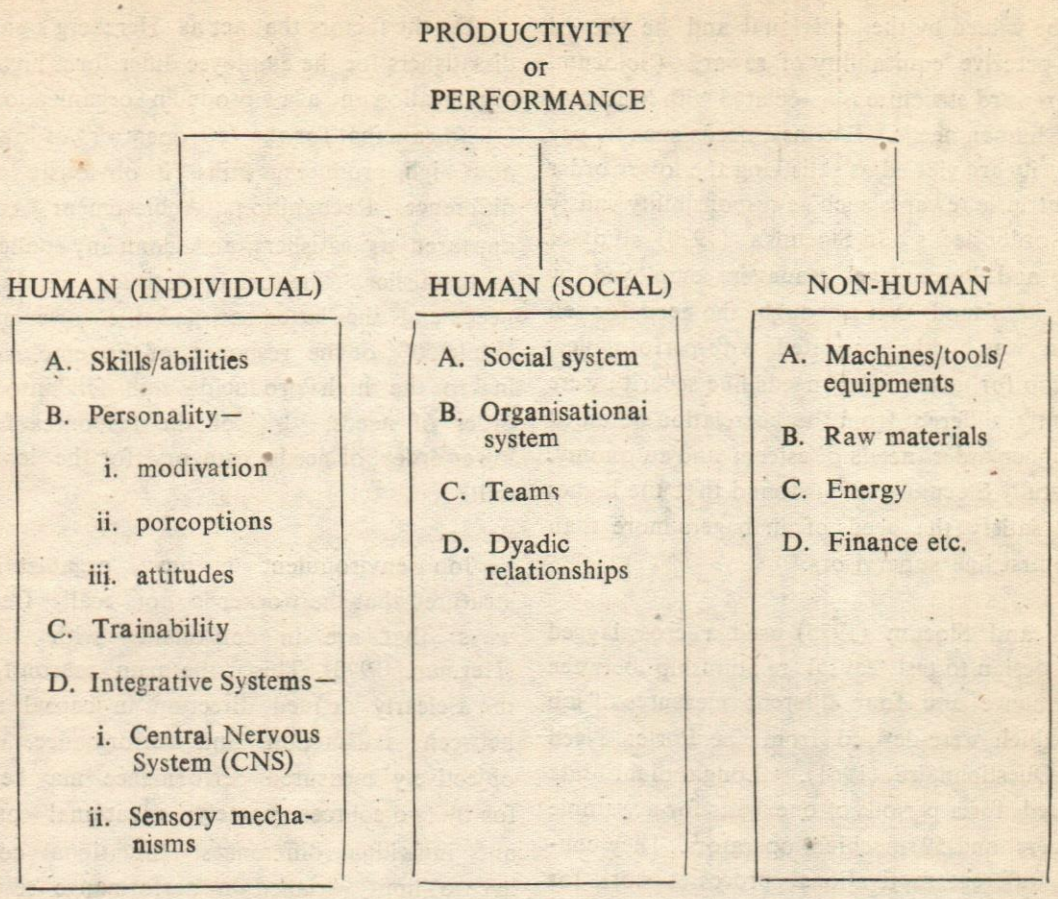
Performance is the outcome of three major sets of variables : Human (individual), Human (social) and Non-human. These are listed on page 77 :

So, for effective performance, a person must have the necessary abilities, proper motivation and his personality must suit the job requirements, assuming that certain innate abilities are there in an individual, other necessary abilities can be acquired through training. It is with this end in view that Mintzberg speaks of the 'developable skills' in executives. These are : *human skills*, *task skills* and *conceptul skills*.

For effective performance there are a number of conditions contingent upon the organisational structure, its size, culture and environment.

Such factors as design and structure along with task veriables are also known to be linked with productivity. The *immediate environment* of the organisation-task differentiation, business policies, governmental policies, geographical characteristics and client characteristics can all cast significant effects on organisational performance. We also know that the *remote environment* like the international market conditions, availability of strategic raw materials, availability of high technology and various types of international/inter-regional considerations can also influence the productivity of a given organisation.

Enormous effects have been invested by organisational psychologists and management practitioners to isolate and identify contributing variables through experimental and correlational research methods. For example, experimental psychologists such as Hull,



Tolman, Atkinson, Skinner and Locke have postulated various models of motivation which lead to effective performance contingent upon certain other conditions explicity spelt out by them. On the other hand, theorists and empirical researchers like Maslow, Herzberg, Alderfer, Vroom etc. have proposed ways to enhance motivation, satisfaction and performance. The recent emphasis on 'managing motivation' in organisations is an indicator of the importance given to this fact of productivity.

Psychological Studies on Productivity :

Psychologists have contributed immensely to our knowledge of the factors affecting productivity in organizations by conducting experiments and establishing theoretical frameworks. However, little has been achieved as organizational decision makers frequently criticise the relevance of behavioural sciences (H. Weiss). As far back as 1919 Kurt Lewin started applying the principles of psychology to industry when he wrote a paper on the labour in agriculture. Since then Lowin has most successfully used "action" research techniques in improving productivity. During the 1930's and 43's, Lewin carried out several research programmes which lay the foundation for productivity enhancement practices.

The relationship between job satisfaction and performance has invoked considerable debate among psychologists. The main controversy centres around the causality of the relationship. Does job satisfaction affect job performance so that satisfaction with the job leads to higher productivity or does performance affect job satisfaction such that success in previous performance leads to present job satisfaction. Locke (1970) subscribes to the job performance job satisfaction relationship. Porter and Lawler (1968) have formulated a theoretical model where performance leads to rewards which may in turn lead to satisfactian. It is only intrinsic rewards which lead to higher performances and not extrinsic rewards. The reward

has also to be valued by the individual and he should be able to perceive equitability of rewards (Solocum, 1970). This reward structure is associated with Maslow's hierarchy of human needs. Extrinsic needs such as pay and job security are viewed as satisfying the lower order needs and intrinsic rewards such as responsibility satisfy the higher order needs. In Slocum's (1970) study of 200 middle and lower level managers employed by a steel mill he found that although the need for self actualization was highly correlated with performance, the correlation for lower order needs like security were not signficantly different from the correlation obtained from the higher order needs of esteem and autonomy. In another study Slocum (1971) found that the higher order needs satisfy the needs of managers more than those of the first line supervisors.

Sheridan and Slocum (1975) used a cross-lagged correlation design to test causal relationship between work performance and four dfferent measures of job deficiency which were derived from the Porter Need Deficiency Questionnaire (1961). Longitudinal data were collected for a period of one year for a sample of 35 managers and 59 machine operators. They concluded that different motivational processes work for the two groups. For the managers rewards on past high work performance resulted in high motivation and for the operators higher dissatification acted as a "push" factor for attaining higher performance.

When an individual receives feedback about his performance, satisfaction with the job is less effected when either high or low performance is reported (Ilgen, 1972). One reason of this could be that satisfaction with performance is a function of two comparisons:

(a) Subject comparision of his reported performance to expected performance (internal)

(b) Comparison of reported performance to some reference group or norm (external)

When the reported is either very high or low, internal comparison is more important and his position is more clearly defined than when middle performance levels are reported. Here the subject uses his expected performance, or some other external measure to determine his satisfaction level.

Do the factors that act as Herzberg's satisfiers and dissatisfiers for the employee differ for a high producing organization and a law producing organization? Prakasan (1980) saw that for the 150 operators of low producing and high producing mills, it obviously did make a difference. Recognition, Achievement Advancement appeared as satisfiers and company policy appeared as dissatisfier. The former satisfied the higher order needs and the latter satisfied the lower order needs. While 50% of the responses of the employees belonging to the high producing mill fell into the lower order of needs. 91% of the responses fell into the lower order of needs category for the low producing mill.

Job environment in most organizations is so strutured that the worker is not really free to act in ways that are in consonance with his attitudes (Herman. 1973). This is the main reason for not finding a clearly defined direction in causal relationship between satisfaction and performance. Variance in objectively measured performance may be accounted for by two sources. namely; situational contingencies, and individual differences. Situational contingencies act to limit variance in performance setting is so structured that individual difference can determine only a small satistically insignificant portion of the performance variable. Herman (1973) studied the vating behaviour of employees in two different units, where the employees had to vote there for or against union representation. Attitudes were found to be significantly related to voting behaviour. Employees who expressed satisfaction with their working conditions were not union supporters and vice versa. This study demonstrated that when behavioural alternatives are not structured by situational constraints job attitudes predict job performance.

The effects of *goal setting* on performance has received considerable attention from behavioural theorists. Locke (1969), for instance, has reported that the most immediate motivational determinant of task performance is the subject's goal. Moreover, higher the intended level of achievement, higher is the level of performance. Even individuals who set goals that were impossible to achieve performed better than those who set relatively easy goals for themselves.

This result is not conclusive as Stedry and Kay (1966) found contrary evidence with individuals who had set impossible goals for themselves, performing badly.

Does goal setting with maximum feedback lead to better performance and satisfaction than goal setting with minimum feedback? Kim and Hammer (1976) divided 113 blue coller employees of a telephone company into four groups which differed on the amount of feedback they received. The groups received extrinsic+informal praise. intrinsic, intrinsic+extrinsic, and no feedback whatsoever, respectively. In intrinsic foodback the workers rated themselves on number of days absent, cost, service etc. In all the four groups a management by objective system was established with the managers setting weekly goals for the employees. Results indicated that on the cost and safety measures on performance a combination of goal setting and feedback was superior to goal setting alone, On the whole the results showed that while goal setting alone enhanced performance levels, an intrinsic and extrinsic feedback increased performance levels even more. Feedback helps the employees to accept the goals being set for them and provides meaning to the task.

Rakestraw and Weiss (1981) studied the interaction effects of social influences and task experience on the setting of goals, performance and satisfaction. They found that subjects who observed a high performing model, set higher goals for themselves than subjects who observed a low performing model. The subjects who already had experience with the task before being exposed to the high performing model set much higher goals than did subjects who had no task experience. However, where actual performance was concerned, subjects without task experience performed better than subjects with task experience. All subjects used their respective model for the basis of self evaluation. So in an organization it is the new worker who is the most amenable to influences from outside as the environment is uncertain and unfamiliar. As familiarity increases the effects of social influences also tend to diminish.

Goal setting has a direct effect on satisfaction, too. In most researches, satisfaction is seen as a monotonically increasing function of the algebric difference between an individual's perceptions about an outcome and his expectations about that outcome (Spector, 1956; Foa, 1957; Hulin and Smith, 1965; Locke, 1970; Ilgen, 1971) according to Ilgen and Hamgstra (1972), when the situation is perceived as yielding less than expected, the individuals will be less satisfied than when it is perceived as yielding the same as expected. When the situation is perceived as yielding more than expected, the individual will be more satisfied than when it is perceived as yielding the same as expected.

Some researchers have used *self esteem* as a moderator of the relationship between job performance and job satisfaction (Greenhaus and Badin, 1974; Jokson, 1978). Based on Korman's "consistency" theory of work motivation, these studies have sought to see if there is any difference in the performance levels of high self esteem individuals and low self esteem individuals. According to Korman (1970) high self esteem (HSE) persons are motivated to perform well on a task in order to maintain their self image. He pointed out three sources of self esteem (a) chronic self ssteem is a personality trait that is generalize to all situations; (b) task-specific self esteem refers to an individual's feeling of competence for a particular task, and (c) socially influenced self esteem is a function of others' expactations of one's behaviour. This occurs when others have high expectations and communicate these high expectations to the relevant person thus increasing the individuals own feeling of competence.

These three sources of self esteem directly affect individual performance. Greenhaus and Badin (1974) investigated the validity of Korman's predictors and found that the three sources of self esteem were uncorrelated. Only task specific self esteem was significantly (p.01) related to task performance. Moreover correlation between socially influenced self esteem and performance was higher for the high authoritarian subjects then for law authoritarians and this difference was satistically significant. One implication for organizations is that they concentrate their self esteem intervention on high authoritarians or they adopt different techniques for law authoritarians.

Korman (1970) also hypothesized that performance should predict satisfaction only for high self-esteem

persons, whereas satisfaction should predict performance only for law self-esteem persons. The reasoning here is that for HSE persons, the better the performance, the greater the balance with their self concept of competence and therefore greater satisfaction. Whereas LSE persons may desire satisfaction from factors other than effective performance. HSE persons and LSE persons react differently to a state of dissatisfaction with the task. For the HSE person it acts as a motivator to increase performance to make it more congruent with self-image. For LSE persons there is a further decrease in performance of dissatisfied LSE persons and no change in performance for satisfied LSE.

In the study by Greenhaus and Badin, they found that performance led to satisfaction only for HSE subjects but satisfaction predicting performance for LSE subjects received little support.

In the study by Kerrlnkson (1978) of 93 meat processing workers there was no correlation between self esteem and job performance. However good performance gave greater intrinsic satisfaction to HSE subjects than it did for use LSE subjects. For the LSE subjects performance was a matter of indifference with regard to intrinsic satisfaction.

Employes *need for achievement* and its effect on the job performance –job attitude relationship has been studied by Steers (1975), The subjects were female fiirst-level supervisors. Before need for achievement was measured overall performance was weekly related to job satisfaction but not to job involvement. After the high nAch subjects were separated from the law n Ach subjects, performance was seen to be significantly related to both satisfaction and involvement for high n Ach subjects but not for low n Ach subjects. High n Ach subjects place a higher value on attaining their goals, so that when tasks are of a challenging nature, high n Ach subjects set higher expectations and put in more effort in achieving their goals. When high performance leads to concomitant rewards which are both extrinsic, these individuals experience greater satisfaction. On the other hand, poor performance leads n Ach fewer rewards and so lower levels of satisfaction.

A similar study was replicated in the Indian situation by Singh and Shrivastava (1983) and they found no cross cultural difference between Indian and American workers so far as the effect of n Ach on job performance and job satisfaction is concerned.

Many work group situations involve periodic "work changes" built into the production process when these changes are recommended they become an organizational problem as production shops with the intiation of every new change. Edwin A. Fleishman (1965) was interested in finding out if this drop in productivity brought about by work changes were due to attitudinal factors or due to skill learning factors. The subjects were employees of a factory engaged in contract sewing of dresses. Women here were paid on a piece rate basis. The total price payable to the employee is negotiated between the union and the company which contracts for making the dress. Management felt that the slow down in productivity occurred at this stage as workers felt that they could influence the price. This was not valid as the workers are the ones who ultimately loose and not the company. A graph of productivity showed that there is a steep increase in productivity over a seven week period after which a plateau is reached. However a sharp drop occurs whenever a new style is introduced.

In the experimental situation a certain number of workers were allowed to plan out what the next style and price would be, and also determine its operation sequence. At this stage the production curve showed very little drop and his transfer is carried on to the next style even though henceforth the subjects have no decision making powers, After a four month period, when no attempts at group participation were made, the group was back to where it started with a sharp drop in production.

Skill factors cannot account for this drop in production as all the workers are experienced and their job remains the same only the style of dress differs. In the experimental group there was greater participation and involvement by all group members, this perceived participation also effected the other members who were not part of the experimental group and this was the reason why productivity did not decline.

Fleishman concludes that evidence presented in the present study is in favour of an 'attitude' interpretation rather than a 'skill interpretation of production drops and rises.

Behaviourists have sought to determine the effects that reinforcement and punishment have on performance levels. Reinforcement of a particular response helps increase the strength and frequency of that response. In the organizational setting, it would lead to the assumption that providing incentives for high performance should provide motivation for future increases in performance. It is interesting to see the process by which reinforcers affect subsequent behaviour.

Locke (1977) has noted that ".....concepts like 'reinforcement' delude investigators into thinking they understand the organism's behaviour, and thus out off the search for the real courses....." For example money is a very common reinforcer, but it does not act like one for all people and under all conditions.

If reinforcers act to increase the desired response than punishment should act to inhibit the desired response. Feedback information can act as a punishment when it generates negative emotions in the individual. What effect does negative feedback have on individuals ? Studenski (1975) stated on the basis of his study on, "Effect of Punishment and Reward on Performance Level" (1975) that provided emotions which are both positive and negative grow proportionately to the intensity of the stimulus then changes in performance follows the Yerkes-Dodson laws as far as rewards is concerned and follows the stress adaptation curve (Selye, 1960) as far as punishment is concerned. Performance reached its peak when stimulated by moderate rewards and strong punishment but when punishment and reward became too strong there was perceptible decrease in performance.

Individuals differ in their abilities to perform different tasks. Would this difference in performance relevant abilities lead to concurrent levels of satisfaction ? Forbes and Barrett (1978) found that task related ability was negatively related to satisfaction in a simple task, whereas curvilinear relationships between ability and satisfaction were found for the more complex task. Applying this in personnel selection it can be deduced that if the job is very simple, the most capable worker will be least satisfied, So, a decision needs to be made as to whether employee satisfaction or performance should be maximized. One way to optimize both performance and satisfaction involves designing the job so that it becomes challenging for the most capable individual. More research needs to be done to support these conclusions. Studying the relationship between task demands, ability and job satisfaction should be given more emphasis by organizational theorists.

The importance of *feedback* to performance should not be underestimated. Research on performance appraisal, and management by objectives all point out to the need for employees to know how they are performing on their jobs. Ilgen, Fisher and Taylor (1979) have reviewed the literature on feeback and how it effects individual behaviour in performance-oriented organizations. They delineate three sources of feedback, namely; individuals who evaluate other's behaviour like supervisors and co-workers, the task environment resulting from completion or competence in a given task, and individuals providing feedback to themselves (self feedback). If feedback is to be relevant then it should have credibility and the source must be seen as trustworthy. Recipients should also be able to interpret feedback so as to become meaningful to them.

Feedback has either a directional or motivational function (Locke et. el. 1968). It is directional as it tells individuals what behaviours need to be performed in a given role. It is motivator when it acts as an incentive. Feedback coupled with goal setting acts as a significant motivator to performance (Kim and Hamnen 1976).

The individual processes feedback into four stages, namely, perception of feedback, acceptance of feedback, desire to respond to feedback and intended response.

How individuals perceive the stimulus depend on how they interpret it and consequently respond to

it. Greller and Herold (1975) found out that individuals rely most on sources close to themselves for feedback. For instance the self is chosen first, the supervisor next, and the organization last. It is generally found that the individual recalls more accurately positive feedback then negative feedback (Ilgen, 1971). This may be a defence machanism with positive feedback enhancing feelings about one's self.

Feedback is related to the individual's frame of reference. Baron and his associates (1974) found that subjects with an internal locus of control performed better in a self-discovery feedback and individuals with an external locus of control outperformed the internals when the feedback was only available from the experience.

High self esteem subjects raise their self-competance evaluations more after success and lower them less after failure (Shranger and Osenberg, 1970).

Acceptance of feedback will depend on how much the individual thinks it in an accurate portrayal of him. Even here, credibility of the source is an important factor. Griffln (1967) has identified five dimensions of source credibility-experties, reliability, intentions toward the listener, dynamism and personal attraction. Halperin Snyder, Shenkel and Houston (1976) presented personality feedback to subjects from one of the three sources who varied in expertise a Ph.D clinical psychologist, an experienced graduate student or an under graduate with a mental health technician's degree from a junior college. The first two sources were seen as significantly more credible than the third.

From a review of literature (Ilgen, 1979) three dimensions of feedback emerged as important influences in the subject's desire to respond. There were timing, frequency and the type of feedback.

Although superiors were seen at the most important source of feedback evidence suggests that they do not give accurate feedback especially when the feedback is negative. Fisher (1973) found that there was a tendency for negative feedback to be conveyed sooner than positive feeback. In addition supervisors tended to rate employees more truthfully when they thought that the feedback report will not be recalled to the respective worker (Ilgen, 1979). They raised their evalutions when they had to give it in person. Another marked tendency of supervisors is to attribute causes to the performance levels of subordinates, (Ilgen, 1979). When performance level, ability and effort were manipulated, supervisors gave less appropriate feedback when performance was attributed to ability rather than effort, this acts as a major handicap to those perceived to be poor performance for reason of low ability.

Pareek (1976) provides us with some direction in order to make feedback more effective. Feedback should be :

1. Descriptive and not evaluative
2. Focus on the *behaviour* of the person and not on the person himself
3. Data based and specific and not impressionistic.
4. Reinforcing positive new behaviour
5. Suggestive and not prescriptive
6. Continuous.
7. Mostly personal, giving data from one's own expertence.
8. Need-based and solicited
9. Focussed on modifiable behaviour
10. Satisfy the need of both feedback giver and receiver
11. Checked and verified
12. Well timed
13. Contributing to mutuality and build up the relationship.

In performance counselling Pareek and Rao delineate three main process-communication, influence and helping. Communication involve empathizing and giving accurate feedback. In influence the snpervisor should increase the autonom y of the person instead of creating a dependence on the supervisior. And finally helping needs a lot of empathy, establishing a mutua-

lity of relationship and identifying the developmental needs of the employee.

Some research has concentrated on accounting for differential levels of productivity amongst farmers in the third world countries (Sandhu and Allen, 1973; Ray and Singh, 1980) on the basis of their study, Sandhu and Allen and Sutcliffe came to the conclusion that productivity levels cannot be accounted for by individual differences. Contrary evidence is provided by Ray and Singh (1980). On the basis of data accumulated from a battery of personality tests including the Hindi adapation of Moclalliamda TAT measure of achievement orientation and by measuring differences in output for a four year period (1970-74) they concluded that certain psychological variables acted as predictors of performance. Their subjects were 200 farmers from Punjab. Intelligence and achievement motivation came across as a powerful predictor of performance. Three further predictors were career, interest, self sentiment and narcissism. One reason why achievement orientation acted as a powerful predictor of performance, was the high reliability of TAT which although not very high, is much higher than that usually obtained in the West. This could also be because the farmers were more truthful in their responses, not suspecting that they could manipulate and trick the results (Ray and Singh, 1980).

What is the effect of group structure on productivity ? Kabanoff and O'Brien (1979) studied the cooperation structure and the relationship of leader and member ability to group performance. In this study, 144 undergraduate students were divided up into 48 three-person groups. Each group varied in the amount of cooperation, collaboration and coordination. In collaboration group members work on a task simultaneously, whereas in coordination subtasks are arranged in order of precedence and each individual must make some contribution to the task. Results pointed out to the superiority of the cooperation structure, in terms of productivity, over the collaboration structure. The groups were also divided in terms of high ability leaders and high ability subordinates. Whatever the group structure when leader and group members had high ability, their performance was better than when both leader and subordinate had low abilities. so while the creative ability of groups was an important determiner of performance, the structure which the group adopted for problem-solving was also important.

Since productivity is so important to organizations, Cotton (1976) believes that planning for better results is a very important component in productivity. The planning process occupies three stages :

1. *Preparation*—Wherein the foundation is laid down and goals are mapped out.

2. *Planning*—The available opportunities are analysed, objectives focussed on and a plan of action formulated.

3. *Performance*—creative adapaptation of the plan to reality. Productivity planning also involves three stages :

1. Developing effective planning process and structure in the organization. The planning structure should fit in with the organizational structure and management and staff should collaborate in the planning process.

2. Productivity goals are established taking into account environmental constraints, conflicting goals etc,

3. Provision of productivity assistance—this acts as a facilitator in the productivity process. Assistance should be provided by industrial engineers, systems analysis and others in the organisation.

In the light of the above, we can safely conclude that productivity is a complex problem. We can not develop clearer insights into it unless we agree to explore the human variables in depth. Available literature very clearly indicates that psychological variables can act as potent determinants of productivity.

BIBLIOGRAPHY

1. Saron, R.M., Cowan, G., and Ganz, R.L. "Interaction of locus of control and type of performanee feedback." *Journal of Personality and Social Psychology*, 1974, 30. 285-292.

2. Cotton, F.E. In Productivity, Planning is Everything'. *Industrial Engineering*, 1976, 8, 11.

3. Fleshman, E. "Attitude Versus Skill Factors in Work Group Productivity", *Personal Psychology*, 1967, 18,3.

4. Foa, V.G. "Relations of Worker's Expectation to Satisfaction with the Supervisor.' *Personal Psychology*, 1957, 10, 161-168.

5. Forbes, B & Barrert, G. "Individual and Task Demands in Relation to Performance and Satisfactation on Two Repetitive Monitoring Tasks." *Journal of Applied Psychology*, 1978, 63, 188, 196.

6. Giffin. K. "The Contribution of Studies of Source Credibility to a Theory of Interpersonal Trust in the Communication Process." *Psychological Bulletin*, 1967, 68, 104-120.

7. Greenhaus, D.H. & Badin, D.I. "Self Esteem, Performance, and Satisfactions: Some tests of a theory." *Journal of Applied Psychology*, 1974, 59; 722-726.

8. Greuller, M.M. and Herold, P.M. "Sources of Feedback: A preliminary Investigation". *Organisational Behaviour and Human Performance*, 1975, 13(2). 244-256.

9. Halperin, K., Snyder, C.R., Shenkel, R.J., and Houston, B.K. "Effect of source status and message favourability on acceptence of personality feedback." *Journal af Applied Psychology*, 1976, 61, 85-88.

10. Herman, J.H. "Are Situational Contingencies Limiting Job Attitude—Job Performance Relationships?" *Organisational Behaviour and Human Performance*, 1973, 10, 203-221.

11. Hulin, C.L., and Smith, P.C.: "A Linear Model of Job Satisfaction." *Journal of Applied Psychology*, 1965, 49, 206-216.

12. Ilgen, D.R. "Satisfaction with Performance as a function of the Initial Level of Expected Performance and the Deviations from Expectation. *Organisational Behaviour and Human Performance*; 1971, 6, 345-361.

13. Ilgen, D.R. Fisher, C.D., and Taylor, S.M. "Consequeuces of Individual feedback on Behaviour in Organisations." *Journal of Applied Psychology*, 1979, 64, 349-371.

14. Ilgen, D.R., and Hamstra, B.W. "Performance Satisfaction as a Function of the Difference Between Expected and Reported Performance." *Organisational Behaviour and Human Performance*, 1972, 7, 359-370.

15. Inskon, K.O.H. "Self Esteem as a Moderator of the Relationship Between Job Performance and Job Satisfaction." *Journal of Applied Psychology*, 1978, 63(2) 243-247.

16. Kabanoff, B., and O'Brien, G.E. Cooperation Structure and the Relationship of Leader, and Member Ability to Group Performance." *Journal of Applied Psychology*, 1979, 64(5), 526-532.

17. Kanungo, R.N. "Productivity, Satisfaction and Involvement: Some conceptual issues." 1982, Paper presented at 20th International Congress Applied Psychology, Edinburgh, Scotland, July 25-31.

18. Kormon, A.K. Toward An Hypothesis of work Behaviour, *Journal of* Applied Psychology, 1970, 54, 31-41

19. Locke, E.A. Toward a Theory of Task Motivation and Incentives". Organisational Behaviour and Human Performance, 1968, 3, 157-189.

20. Locke, E.A. "Job Satisfaction and Job Performance: A theoretical Analysis", *Organisational Behaviour and Human Performance*, 1970, 5, 484-500.

21. Locke, E.A. "The Myths of Behaviour Mode in Organisations." *Academy of Management Review*, 1977, 2, 543-553.

22. Porter, L.W. & Lawler, E.E. *Managerial Attitudes and Performance*. Homewood, III. : Irwin, 1968.

23. Prakasam, R. "Productivity and Satisfaction", Paper read at the Indian Academy of Applied Psychology Conference October 31-November 2, Ahmedabad.

24. Ray, J.J., and Singh, S., Effects of Individual Difference on Productivity Among Farmers in India". *Journal of Social Psychology*, 1961, 45, 1-10.

25. Rakestraw, T.L. Jr., and Weiss, H.M: Interaction of Social Influence and Task Experience on Goals, Performance and Performance Satisfaction." *Organisational Behaviour and Human Performance*, 1981, 27, 326-344.

26. Sandhu, H.S., and Allan, D.E. "The Village Influence on Punjabi Farm Modernisation." American Journal of Sociology, 1974, 79, 967-980.

27. Selye, H. 'The Stress of Life.' New York: McGrew-Hill, 1956.

28. Sancridan, J.E., and Slocum, J.W. "The Direction of the Casual Relationship Between Job Satisfaction and Work Performance." Organisational Behaviour and Human Performance, 1975, 14, 159-172.

29. Shranger, J. Sr., and Rosenberg, S,E. "Self Esteem and the Effects of Success and Failure Feedback on Performance." *Journal of Personality*, 1979, 38, 404-417.

30. Singh, A.P. & Shrivastava, S. "Effect of Need for Achievement on the Job Performance—Job Satisfaction Relationship." *Indian Journal of Industrial Relations*, 1983, 18, 437-442.

31. Slocum, J.W., Jr. "Performance and Satisfaction: An Analysis." *Industrial Relations*, 1970, 9, 431-436.

32. Slocum, J.W. Jr. "Motivation in Managerial Levels: Relationship of Need Satisfaction to Job Performance." *Journal of Applied* Psychology, 1971. 55 (4), 312-316.

33. Spector, A.J. Expalanation, fullfilment and Morale". *Journal of Abnormal and Social Psychology*, 1956, 52, 51-56.

34. Steers, R.M. "Effects of Need for Achievement on the Job Performance—Job Attitude Relationship." *Journal of Applied Psychology*, 1975, 60 (6), 678- 682.

35. Stodry, A.C. & Kay, E. "The Effect of Goal Difficulty on Performance: A Field Experiment." *Behavioural Science*, 1966, 11, 459–470.

36. Studenski, "Effect of Punishment and Reward on Performance Level." *Polish Psychological Bulletin*, 1975, 6 (2), 89-93.

37. Weiss, H. "Contributions of Social Psychology to Productivity." Chapter from Research on Productivity: Multidisciplinary Perspectives" (forthcoming).

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Incentives and Labour Productivity: An Experience

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Financial Incentives are normally given to boost productivity. However, is it possible to measure their impact on productivity? While seeking an answer to this question, the author has pointed out that the concept of productivity is notional and at a micro level it is extremely difficult to measure productivity, so also the isolated impact of various factors that are responsible in determining productivity. Apart from the practical difficulties in getting data on this sensitive area of industrial operation, the author has shown how it is almost impossible to establish any statistical relationship between incentives and productivity.

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Incentives and Labour Productivity : An Experience

Productivity index is a major indicator of economic department. To be precise, it implies the "changing productive efficiency with which the potential resources of a country or an industry were effectively utilized in the production of real goods and services during a given period of time."[1]

Productivity is broadly defined as the ratio between output and the total input of factors required to achieve it. Being a directly non-measurable phenomenon it is always quantified in terms of a ratio. Thus productivity of capital—fixed or working capital such as fuel, raw material and labour—can be quantified in terms of a ratio between relevant input and output factors.

Productivity of an organisation is determined by a combined and simultaneous effect of complex factors like efficient utilisation of plant and machinery, technological developments in different processes, better planning and organisation of work, efficiency of workers and industrial relations, etc., and it is indeed difficult to isolate and quantify the effect of these factors.

Similar difficulty arises in measuring labour productivity. Most of the formulae that have been availa-

1. Srivastava, J.P. *Labour Productivity : Socio-Economic Dimensions*. Oxford-IBH, 1982.

ble for measurement of labour productivity, do not provide a practical and authentic measure for exact quantification. the reasons behind this are analysed in the following paragraphs.

The most widely accepted definition of labour productivity is output per manhour.

$$P = \frac{\text{Output}}{\text{Manhours}}$$

While it is possible to correctly quantify the number of manhours, measurement of output is quite complicated in multi-product firms where a number of by-products are also manufactured. Moreover the changes in the ratio between total output and the number of manhours do not give an exact idea of labour productivity because it is an end product evolving from the interrelated influence of effective labour utilisation, availability of raw materials skill and effort of worker and so on. As Seigel[2] has pointed out, "labour productivity indices do not reveal changes in the intrinsic efficiency of labour but rather the changing effectiveness with which labour is utilised in conjunction with other factors."

Among other ratios for measuring productivity, a common one is

$$P = \frac{\text{Net value added}}{\text{No. of manhours}}$$

For calculating this value, one has to take into account the depreciation of the machinery. The values of depreciation given in annual reports are very rarely genuine because of the fact that a tax rebate is available on depreciation.

So far as the gross value added is concerned, this is equal to the difference between gross output and input both at constant prices. In this case, it is indeed difficult to obtain price indices of inputs, to deflate current value of inputs. Other problems exist in using the concept of value added : in the event that a firm starts manufacturing some components (instead of buying them) for its major product, it results in its increased productive contribution per unit of finished product. Again it is possible that with inflation the value added in this case would be less than the market price of the same component because of the time lag.

Another measure of quantifying labour productivity is total manufacturing cost per manhour. Higher productivity is supposed to decrease the cost of manufacturing however cost of manufacturing itself depends upon the cost of all factors of production and though it may be ultimately linked with labour productivity, it still does not provide a reliable tool for quantifying labour productivity. Secondly, there is extreme paucity and inadequacy of data with respect to manufacturing costs. As M. M. Mehta[3] has pointed out, "it is a well-known fact that costs are always regarded as a trade secret to which an outsider can hardly have any access.

It is essential to note here that most of the ratios of productivity are notional and they do not give a satisfactory solution of the problem. For instance, labour productivity is also measured in terms of fixed assets per manhour. It is a management function to decide and invest in fixed assets and labour and its productivity have nothing to do with this function so long as we do not have labour ownership in industry.

The above discussed ratios are used at a macro level as an index of development. A question arises as to how the productivity is measured at a micro level.

As stated earlier, it is difficult to measure output if the end product is in multiple commodities, not homogeneous in nature and has a number of bye—products. Therefore, in most of the engineering companies, output is converted in standard hours. A standard hour is time allowed for a product delivered to stores by an individual worker or a group of workers. For instance, if the total time allowed to produce one product is fifteen minutes (.25 hour) and 1000 such tools are delivered to stores in a month, the resulting hours will be $0.25 \times 1000 = 250$ hours. Despite the allowance given for rejection, fatigue, machine setting, tool crib, etc., the standard hour is calculated by taking into consideration the ideal situation with respect to normal

2. Seigel, I.H. *Concepts and Measurement of Production and Productivity*, Washington, 1952, p. 21.

3. Mehta, M.M. *Measurement of Industrial Productivity*, The World Press Limited, Calcutta, 1955, p. 20

speed of a worker and his willingness to work. In practice, it may vary due to absenteeism, mood of a worker and so on. Labour productivity being a product of labour utilisation and efficiency, it is circulated as follows.

$$\text{Productivity} = \text{Labour utilisation} \times \text{Labour efficiency}$$

$$= \frac{\text{Standard hours available shift hours}}{\text{actual hours worked (Direct labour hours)}} \times \frac{\text{available shift hours}}{\text{actual hours worked (Direct labour hours)}}$$

$$= \frac{\text{Standard hours}}{\text{actual hours worked (Direct labour hours)}}$$

Productivity and Incentives

Incentives are given as extra financial motivation for promoting productivity and they are directly measurable. However, there are a number of factors that affect the quantum of incentives. These are, number of days worked in a month, demand for a product (which would determine the piece-work load) and so on. Thus the incentive amout does not reflect the real productivity and vice versa.

One can however, adopt three approaches for making a quantitative analysis of impact of incentives on productivity.

1. Comparison between pre-incentive and post-incentive period in the same company with respect to labour productivity.

A major hurdle here is that most companies do not maintain data for more than two years so that in the companies where the span of the incentive scheme is longer, data for pre-incentive period would not be available.

2. Comparison between factories where there are incentives and those where there are no incentives. Such comparison will have limitation with respect to the lack of common variables such as management policy technology and capacity utilisation, age of the organisation, organisational culture, role of the trade union, demand for products, etc., which have a direct bearing on productivity.

3. Comparison of impact of incentive from one agreement period to another. Inflation plays a decision role in the quantum of incentives and therefore, this approach too has its own limitation.

A more important difficulty, however, was in getting data from companies. Some companies flatly refused to give data on productivity as they felt that it would expose the day-to-day working of their organisation. In spite of these difficulties, a pilot study was conducted in an engineering firm to find out the relationship between labour productivity and incentives. This data is presented in the following table.

Month	*Standard hours*	*Direct labour hours*	*Labour productivity index*	*Incentive amount* *
A	B	C	D	E
June 1981	1879	1895	91	430.75
July	1811	2199	87	435.6
August	1807	2503	83	423.00
September	2012	2339	80	347.5
October	1437	1808	78	242.0
November	1621	1880	82	317.5
December	1880	1944	87	384.9
January 1982	1207	1969	81	310.0
February	1593	1577	85	308.72
March	1731	2051	81	321.12
April	1547	1945	87	391.00
May	2159	1974	91	462.8

* For a group of approximately 10 workers.

Figures in the Column D above; are the ratios between cumulative standard output hours and direct labour hours of three months with retrospective effect. That mean the index for the month of August is the ratio between the standard hours and the direct labour hours for the months of June, July and August- These two factors (i.e., numerator and the denominator) vary depending upon the work load, absenteeism and other factors related to production and yet the productivity ratios could be the same over the period. (See for instance the ratios for July, December and April and January and March.)

Now let us see how the incentive amount is calculated.

Payment in paise per hour = 11 + .7333 (Efficiency—75)

Payment for the month of

August = 11 + .7333 (83—75)

$$= 16.86 \times \frac{\text{Direct labour hrs.}}{2503}$$

= 423 (Rs.)

Thus while the actual payment of incentives is done on the basis of the direct labour hours for a particular month, the productivity ratios are calculated with an average of three months. These ratios are calculated only to see the extent to which the productivity has deviated from the minimum required productivity standard (i.e., 75%) and it does not have a direct bearing on incentive amount. The rates of incentives differ for each one per cent increase above the minimum required productivity index. Further the direct labour hours too change from one month to another with the result that it is impossible to establish any statistical relationship between productivity and incentives so as to study the nexus between the two.

A question arises as to what extent such a minor amount (Rs. 430 for a group of 10 workers or Rs. 43/- per worker) would motivate workers to work? (whose gross wages apart from piece rate earnings and group incentives vary from Rs. 1044 to Rs. 1250/-). It is possible that it would reduce the dissatisfaction rather than act as financial motivator. For it is piece-work load that determines the major part of the monthly earnings of a worker. However, separate record of piece-rate hours was not available so as to enable us to relate productivity and incentives.

Had the incentive been paid on daily basis or immediately in the following month (that too depending upon the actual labour hours and on the ratio as it is done in the above examples) it would have been possible to study the leading effect of incentives on productivity. Even for studying such motivational impact one would have to consider other aspects of human factors in production as constants. (For instance, the mood of a worker,—it is observed that on the following day and the previous day of a weekly off production is at a lower ebb).

Several studies in India and abroad have shown that monetary payment is not the only motivating factor for workers. The non-monetary incentives play a decisive role in work motivation and thereby labour productivity. However, isolating the effect of these two is nearly impossible.

A more important point however, is that, both monetary and non-monetary incentives will have different impact on different people. As Harvey Leibenstein[4] has pointed out, "some people are less motivated than others; and the same people appear to be more motivated in some circumstances than others. Economic behaviour, the amount and nature of effort that people put forth in their economic affairs, is in response to such differential degrees of motivation. Furthermore, different environments create and affect the degree of motivation that exists in different contexts. These elements influence to a significant degree the cost of production and output in the economy. The theory as currently constructed cannot handle "differential motivation."

Human behaviour is highly unpredictable and especially in the field of industrial relations, where the conflict is inherent in the system itself, it is extremely difficult to quantify and predict the intensity of state of relations between management and labour.

The same principle is applicable to measurement of labour productivity. Productivity is an outcome of a combination of a number of inter-related factors. It is therefore difficult to single them out and consider their effort individually.

4. Leibenstein, Harvey. "Microeconomics and X-efficiency Theory : If there is no crisis there ought to be" *in The Crisis in Economic Theory* Eds ; Daniel Bell & Irving Kristol Basic Books Inc., N.Y. 1981.

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Causes of Low Productivity : Some Human Factors

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There are a number of factors which are responsible for low productivity, for example faulty communication, formation of informal groups, decision making process and many other complex human relationships that pervade administration. The authors suggest that it is the total organization and not merely some key individuals, who must be studied if the total system is to be properly understood, because industrial organization is not only a production system but a socio-technical system, requiring attention to both production and people.

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In the past few decades, the behavioural sciences have grown in importance in Industry. Why this shift? It is largely because the critical problems in modern industry tend to be more and more human problems.

As organizations grow and become more complex, technical problems form a smaller share of difficulties faced by management. At the same time, the social, psychological, and cultural complexity of large organizations leads to an increase in the rate and proportion of "people" problems.

We spend a significant portion of our lives at work and our experiences during the working day can influence our feelings, emotions and activities for the other portion of our lives. Studies and Survey have demonstrated that when a person is unhappy, frustrated, or dis-satisfied at his work, he is likely also to be unhappy at the end of the workday when he returns his family. Thus for our emotional and social well being, and for the economic advantages of the companies for which we work (since the unhappy worker may also be unproductive), the job and the job environment must provide more than a means of livelihood. In other words two things are of major concern—the individual worker and the organization for which he works. These two are the opposite sides of the same coin—which needs to be studies in totality, within the context of organization's culture.

In fact organization culture is the prevailing back-

ground fabric of prescriptions for behaviour, the systems of beliefs and values, and the technology and task of the organization together with the accepted approaches to these. I would go to say that an organizations culture serves powerfully as a determinent of behaviour. If the culture suports behaviours appropriate for organization goal attainment, the result will probably be an effective organization; if the culture supports behaviours obviating goal attainment, the result will probably be an ineffective organization.

In addition, the organizations culture may operate to enhance human values or may operate to thwart them. By human values I mean those goals and strivings of individuals that relate to what they want from the organization and from their participation as organization members. Some human values that seem to be important today are the following—

(a) The opportunity to make a meaningful contribution to the organization.

(b) The opportunity to have satisfying interpersonal relationships.

(c) The opportunity to accept responsibility.

(d) The opportunities for recognition and advancement.

(e) The opportunitics to stretch oneself and to grow.

The term 'culture' in this paper includes the notion of the 'informal system" (which is comprised of groups within the formal system), as including feelings, informal actions and interactions, group norms and values. In some ways the informal system is the hidden suppressed domain of organisational life—the covert part of the 'organizational iceberg' as shown below.

Formal (covert) aspects

Goals
Technology
Structure
Policies & Procedures—Products
Financial resources

Informal (Covert) aspects

Perceptions
Attitudes
Feelings (anger, fear linking, despair, etc.)
Values,
Informal interactions
Group norms

About the formal and informal systems

Traditionally, this hidden domain either is not examined at all or is only partially examined. If the organizations are to develop a healthy climate, focus must be on both, the formal and the informal systems. It is usually through the informal system, in the sense that perceptions, attitudes and feelings are usually the first data to be confronted. We must not forget that people in organizations develop a psychological contract" between themselves and the organization. This contract is more often referred to as 'reciprocation'. No doubt the organization enforces its expectation through the use of power and authority, while the employee enforces his expectations by attempting to influence the organization or by withholding his participation and involvemnt—as when he goes on a strike or alienates himself. Both parties in this psychological contract are guided by assumptions as what is fair, equitable, and correct. Work and life can become richer and more meaningful, and organized effort more effective and enjoyable, if feelings and sentiments are permitted to be a more legitimate part of the culture of organization.

Another factor, which is usually ignored, is the formation of informal groups within the formal set up. These are based or 'we' feelings and here the relationships are not as they are expected to be, but as they really are. These groups if channelized in the right direction, can contribute toward morale, productivity and haman satisfaction. Here the logic of sentiment prevail over the logic of efficiency and productivity, because workers attitudes and effectiveness are conditioned by social and emotional demands from both inside and outside the work plant. So much so, it has been observed by number of studies that the need for recognition, security and sense of belonging is more important in determining worker's morale, and productivity than even the physical conditions under which

they work. We must always take account of the fact that these formal groups within the work plant exercise strong socio-cultural controls over the work habits and attitudes of the individuals worker.

Besides, 'organization culture' and the formation of informal groups, communication plays a major role in determining how effectively people work together and co-ordinate their efforts to achieve objectives. Put even more specifically, there is a direct relationship between communication and productivity. Employees work more effectively and with greater satisfaction when they understand not only their own job objectives but also those of their work group and the total organization. The barriers to creating understanding and thereby getting co-operation and enthusiasm from people can be classified into two categories. First, the technical barriers which relate to the organizational framework in which communication occurs—second are those barriers which are human in nature, and it is the latter which is important from the social and cultural factors.

The first important human barrier to effective *communication* is failure to see the need. Poor communication is very often not so much a problem of someone not wanting to communicate or not knowing how as it is of realizing *why* certain information is important to another individual or department. The first step toward overcoming this barrier is a realization and crystalization of what information we should be communicating. The second step to overcoming the failure to see the need is developing empathy, the ability to put ourselves in the other man's shoes. Once the individual develops a sensitivity as to how he feels when someone does not communicate with him, he is more likely to do a better job of communicating with others.

A second barrier is embodied within the concept of semantics—the meaning of words. This barrier can become operative in a number of different ways, for example, using specific words with which the receiver is not familier, using words which have a variety of meanings and assuming they are interpreted the way they were meant, talking over the head of the receiver in general, or making a message unduly complicated and long. For example, the industrial engineer who talks to the line supervisor about 'therbligs' or economic lot sizes may meet with no response. Similarly, the line supervisor who tries to train a new worker using unfamiliar terminology or 'shopjargan' may find that he 'cannot get through'. Taling over people's heads usually results in creating a negative impression and consequently, getting negative results. A third human barrier involves the failure to listen. When a sender does not listen, he has no way of getting feedbeck to see if his message is being understood. Often other problems presented by people in organizations also result both from their perception of the role expected of them by the organization and their own individual motives and attitudes. A final human barrier is inadequate planning in terms of the what, when, how, where and why of communication. Before every communication commences, these questions should be asked.

Good communication does not occur by accident. Like anything else, it requires some advance planning, and the time spent in planning is usually more than compensated for in long-run results. Similarly, most communication failures can be traced to one or more failures in the planning stages.

Further, communication plays a great role in interpersonal dynamics and thus has its bearing on decision-making process too. Decision making should be seen as a process in which many persons in the organization exert their influence, not just those at the policy or management level. It is a recognised fact that no single individual alone ever makes decisions in administra tion. He is always influenced by other persons, whether present in person or in spirit, and his conclusions are the result of advice, objection, hostility, fear, envy admiration, contempt, involving a complex of human relationships that pervade administration.

Therefore it is essential that to day's managers/administrators realize that it is necessary to analyse the background factors that affect decision making—the perception of the decision maker, and those affected by the decision, the analytical steps in decision making, and the action and reaction to the process itself.

Suggestions

In order to minimise the 'human problems' which may be one of the causes of low productivity, it in

desirable that some corrective measures be taken and for that I feel that each industrial organization should set up a *'behavioural sciences cell'*, as a part of its formal structure. As all over the world it is a recognised fact that technological effort needs to be socially and culturally relevent. The objectives of such a cell should be :

(a) To carry out research into behavioural problems-like absenteeism, accidents, and mental health, etc.

(b) To carry out socio-psychological surveys for determination of community needs, attitudes, and opinion of the people. The information gethered will be helpful to management in under-standing employees motivation and work goals and how these change over time. Surveys tap feelings about pay, promotion, co-workers and the work itself.

(c) This cell should also act as an extention and render consultancy and counselling services to the organization, based on its findings.

(d) To develop psychological testing tools for, selection—promotion etc., for its personnel.

All this is essential, because we must examine the conditions under which organization is a threat to the individual, and the safeguards that can be built into organization to minimise it. We must discover how to design organization and technological systems in such a way that individual talents are used to the maximum and human satisfaction and dignity preserved.

With the rapid growth of technology, the expansion of economic markets, and rapid social political change, come constant pressures for organizations to change, adapt, and grow to meet the challenges of the environment. It is the total organization, not merely some key individuals, who must be studied if this process is to be properly understood, becaûse an industrial organization is not only a production system; but a socio-technical system, requiring attention to both, production and people.

Productivity
1984, XXV, 1, 95-99

Measurement of Productivity

DR. NAR SINGH

There are at least three alternative methods of measuring productivity (a) the gross output (in physical terms) per man-hour, (b) the gross value of output per man-hour, and (c) value added by manufacture per man-hour. One of the main shortcomings of these methods is the inability to calculate the relative contribution of the foctors. It has, therefore, been suggested marginal productivity concept in order to isolate the factor and to find out its relative productive as a unit of investment. For this purpose, I have used Cobb-Douglas type production function to estimate marginal productivity of labour and capital and suggest a formula in order to examine the equity in distribution to the respective factors.

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(i) The Purpose

The classicists were interested in productivity measurement because they wanted to determine, or explain the distribution of social income among the groups which produce it.[1] They were of the view that share of each factor in a competitive economy is directly related to its marginal productivity (i.e., the value added to the output by a small increment in each input factor at the margin). Therefore, labour and capital being chiefly responsible for the fotal produce were to be rewarded with wages and profits respectively according to their marginal productivity. Secondly, productivity measurement was also deemed to help in measuring the progress of a society over period of time and comparing societies with respect to economic efficiency.

My purpose of measuring productivity in the present paper is to suggest a formula to estimate of factor productivities—labour and capital—in order to examine the equity in distribution to the respective factors.

(ii) Methods of Productivity Measurement

There are three alternative methods of productivity measurement which mainly deal with international comparisons.[2] (i) The global method is mainly based

1. Editor's Notes ; Dynamics of Productivity. Special Issue on Measurement of Productivity, *Productivity Journal*, National Productlvity Council, Delhi, Vol. 3, No. 1, November-December, 1961, p. 1

2. Rostas, L., 'International Comparisons of Productivity', *International Labour Review*, Vol. LVIII, September 1948,

on the comparison of the total volume of output and total employment in a given industry of the different countries. It may, however, be adapted for purposes of a single country by taking the volume of output and employment for all industries at the different periods. (ii) The sample method is completely based on the comparison of the performance of a few number of selected mills in a particular industry producing identical products under broadly identical conditions. (iii) The net output value method is based on a comparison of the value of net output per head in the two countries, converted into the same monetary unit.

Jean Fourastie[3] advocates the use of both direct and methods is used in the workshop and on the factory floor within a single firm or in a group of firms, while the indirect method is used outside the firm with the help of the general statistical year books of the various countries, monthly or quarterly publications by national or international institutions.

Productivity measurements through direct method are usually ill-adapted to economic and social analysis, because they are to a great extent, too confined to a single undertaking, and too localised in time and space. The indirect method of productivity measurements however, enables us to study the fundamental relationship between increased productivity and social progress. It reveals the position of one particular firm in relation to all other firms in the same sector of the national economy and is useful for economic forecasting also.

(iii) Productivity Formulae

The formulae of productivity measurement which have been evolved from time to time, have to serve different types of purposes. The application of a particular formula depends upon the availability of data. Some of these formulae are briefly discussed below :

(*a*) *Productivity Formula Based on Economic Unit* : A productivity formula which relates to an economic unit producing a wide range of goods can be put as under :

$$\frac{\text{Value of Output}}{\text{Value of Input}}$$

Such an approach, however, bears the least practical utility because neither it is useful for comparison of the productivity of two units or nations, nor it reveals productivity of any individual factor. Since there is likelihood of significant changes in the comparative price levels of the two different countries over a period of time, the results based on this method may provide unsteady picture while attempting for productivity comparisons at the international level.

(*b*) *Productivity Formula based on 'Physical Output'* : The formula based on physical output may be adopted for measuring productivity at the industry level. In case of industries manufacturing a single product, the measurement of productivity is simple. Algebraically, productivity is measured by q/m where q is quantity or units of output produced and m is number of man-hours worked. A change in productivity between two periods can, thus, be written as :

$$\frac{q^1}{m^1} \Big/ \frac{q^\circ}{m^\circ} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(i)}$$

where suffixes ° and 1 denote the base year and the current year respectively. But this formula is useful to a limited extent because majority of the industries manufacture different types of products and there is hardly any industry manufacturing a single product alone. Hence its wider application is doubtful.

(*c*) *Productivity Formula Based on the 'Price Method'* : Price method is an indirect method of productivity measurement. Just to illustarate we can assure that value of production is equal to value of factors of production, where the latter includes profits to entrepreneurs also. Hence, I volume of products × I price of products = I volume of factors × I price of factors, where I signifies index. Following this, the productivity index of current year can be calculated by the ratio :

$$\frac{\text{I volume of products}}{\text{I volume of factors}} \quad \text{or} \quad \frac{\text{I price of factors}}{\text{I price of products}}$$

This is the common formula on which the price method is based. This method can be used for time series analysis of total productivity trends.

(*d*) *Productivity Formula Based on the 'Real Price Method'* : The Real Price Method rests upon two basic

3. Fourstie, Jean, *Productivity, Prices and Wages*, Paris, 1957, p. 9.

assumptions : first' we assume that the variety of manufactured products 'A' in an economy are of a specific nature. Secondly, it is also assumed that incomes other than those earned from labour can be disregarded and the incomes earned from the work done previously have been congruently actualised. Under these assumptions the formula 'Value of Production—Value of Factors' enables us to write : Quantity of Products A × Price of Product A = Number of working hours × hourly working income, and hence :

$$\frac{\text{Quantity of product A}}{\text{Numberof working hours}} = \frac{\text{Hourly earnings from labour}}{\text{Price of product A}}$$

if we, then, call the ratio of

$$\frac{\text{Price of product}}{\text{Hourly earnings from labour}}$$ 'the real price',

it becomes quite clear from this, productivity is the inverse of real price.

(iv) Main Limitations

Some of the limitations of the above mentioned formulae for productivity measurements are stated below :

In almost all the studies of labour productivity we find that economists in general have treated labour as a homogeneous entity.[4] They have not made any distinction between workers of different skill, aptitude or application. This may be because of lack of data for such classification of labour force employed in most of the industries as can be seen in various reports of Census of Manufacturing Industries (CMI) and Annual Survey of Industries (ASI). Moreover, the 'Man-hour' is also not homogeneous concept for its influence on production differs widely according to the sex, age, skill and the position of a worker in the factoy in which he works. For example, for a manual job, a man's hour of work will, on an average, represent more labour than a woman's or a child's hour and, therefore, large quantitative differences may appear in the output of different workers, i.e., adult male, adult female and child labour. In case of non-manual work, differences between individuals are qualitative, as well as, quantitative and attempts have not been made so far to develop any method or formula for measuring these types of differences. Moreover, the hours of work of skilled workers are not interchangeable, because different jobs require different types of technical competenance. The skill of workers will have a direct bearing of labour productivity, and differences in productivity figures due to this factor could be eliminated only if the varying composition in skill, age, etc., of the labour force could be taken into account in the measure of the total manhours worked or of persons employed.[5] Also there are considerable difficulties in obtaining sufficient and reliable data on the number of manhours worked. The statistics for total annual manhours worked by wage earners are only rated and usually fragmentary.[6]

On the other hand, the main difficulty in measuring the output is that of summating the hectrogeneous output.[7] The measurement of output in terms of phyical units is easier in industries having a simple product structure as cotton textile, cement, sugar, etc. However, difficulties are experienced particularly in case of those industries producing varieties of finished goods differing in quality, size, shape, or design. Beside this, it is rather difficult to measure quality differences of units of a product due to the differences found in variety, size, shape, durability and style. Moreover, these quality differences are sometimes invisible or imperceptible.

(v) Choice of Formula for Operational Analysis

In view of the above limitations, an attempt has, therefore, been made here to measure the productivity of labour and capital with the help of Cobb-Douglas type production function which is linear in logarithms.

4. *Productivity Measurement Review*, European Productivity Agency, No. 20, February 1960, p. 49.

5. Balkrishna R. : 'Productivity and Its Measurement', *Productivity Journal*, National Productivity Council, New Delhi, 1961, p. 17.

6. Fabricant, S. : *Employment in Manufacturing Industries : 1889-1939*, National Bureau of Economic Research, New Delhi, 1942, pp. 49-50.

7. Peter O. Steiner and William Goldner, 'Productivity', *Productivity Journal*, National Productivity Council, Delhi, November-December 1961, p. 23.

Fourastie, Jean, *Productivity Prices and Wages*, Paris, 1957, p. 9.

Heathfield, D.F., *Production Functions*, Macmillan, 1971.

Kendrick, John, W., *Productivity Trends in the United States* NBER, New York, 1961.

Mehta, M.M., *Measurement of Industrial Productivity*, Calcutta 1965.

Mehta, S.S., *Productivity, Production Function and Technical Change*. New Delhi. 1980.

Mongia, J.N., Measurement of Labour Productivity, *International Labour Review*, Vol. LXVI, No. 2, August, 1952.

National Productivity Council, New Delhi, Measurement of Productivity, *Productivity*, Special Issue, Vol. 3, No. 1, November-December, 1961, p. 1.

OEEC, European Productivity Agency, *Productivity Measurement Review*, No. 24, February, 1961, pp. 12-13.

Productivity Measurement Review, No. 20, February, 1960, p. 49.

Peter, O. Steiner & William Go ldner, Productivity, *Productivity Journal*, National Productivity Council, New Delhi, November-December, 1961, p. 23.

Rostas, L., International Comparisons of Productivity, *International Labour Review*, Vol. LXIII, September, 1948.

Siegal, Irving H., *Concept and Measurement of Production and Productivity*, Washington, 1952.

Sinha, J.N., & Sawhney, P.K., *Wages and Productivity in Selected Indian Industries*, Vikas Publication, New Delhi, 1970.

Tewari, R.T., and Sinha, R.C., Productivity Trends and Factor Compensation in Indian Cotton Textile Industry, *Indian Journal of Industrial Relations*, Vol. 7, No. 2, October 1971, p. 179.

Tinterner, G., 'A Note on the Deviations of Production Functions from Farm Records', *Econometrica*, No. 12, 1944, p. 26.

Vincent, L.A., The Main Formulae for Productivity Measurement in a National Economy or Sector, *Productivity Measurement Review*, Paris, No. 25, May, 1961, p. 7.

Various measures are adopted for improving the entire situation by way of concentrating attention on worker as "HUMAN ADULT" and its environment. This is achieved by—improving workplace ergonomically; improving material handling; facilitating in-process material storing; achieving cleanliness and orderliness all over shopfloor; better shopfloor layouts and even utilizing some sophisticated machines and toolings etc. Apart from the above also described are the measures such as Suggestion Scheme, modification of Incentive Scheme, Training for educating and development, Communication system, Safety Cell, Extension of Transport facility and our settlements with the Union.

The Organization

In the year 1957 i.e., 25 years ago Siemens India Limited made a modest beginning with its manufacturing activities as a Switchboard factory at worli (Bombay) with a sales turnover of Rs. 14.0 million and with a strength of only 475 employees. During the past 25 years, Siemens India has widened the scope of the manufacturing field in Electrical Engineering. The Company manufactures a variety of items and equipments like High and Low Voltage—Switchgear, Switchboards, Motors, Equipment for Power Electronics, Railway Signalling, Component Data and Communications, Process Control and Instrumentation and X-Ray and Electro Medical equipments. To carry out the manufacturing operations, it has factories at Bombay (Worli) at Kalwa—40 km away from Bombay and at Nasik in Maharashtra and at Hide Road and Joka in Calcutta (West Bengal). The Registered Office and Head Office are situated at Worli, Bombay. It has a Sales network all over India through their Regional Offices at Bombay, New Delhi, Calcutta, Madras and Branch Offices at Ahmedabad, Bangalore and Hyderabad. In addition to this to cater the needs of local clients there are Resident Sales/Service Engineers at Chandigarh, Lucknow, Srinagar, Ludhiana, Jaipur, Kanpur, Varanasi, Durg, Bhopal, Ernakulam (Cochin), Gauhati, Patna and Rourkela. The total Sales Turnover of Siemens India during 1982-83 was Rs. 143.8 Crores and it has more than 6500 direct employees on its roll.

Today the major manufacturing activities are at Kalwa, Thana near Bombay—a nerve centre of Indian Industry and it occupies a site of 2,40,000 sq.m. Initially at Kalwa, onlv Motor Factory was installed in 1966. Subsequently Switchgear Factory from Andheri, Bombay and Switchboard from Worli, Bombay were shifted to Kalwa in 1973 and 1975 respectively. Production at Kalwa covers a wide range of electrical equipments such as LT and HT Motors, LT Control Panels (Power Control Centre/Motor Control Centre), HT Switchboards, LT and HT Circuit Breakers, Contractor and Relays, Point machines and Actuators.

Siemens India has played an active role in India's Industrial development and Company has executed major turn key projects in a wide variety of national development endeavours/projects like—

(a) Bhabha Atomic Research Centre
(b) Electricity Boards of Maharashtra and Punjab
(c) National Mineral Development Corporation
(d) Indian Farmers Fertilizers Corporation
(e) Fertilizer Corporation of India
(f) National Coal Development
(g) Damodar Valley Corporation
(h) Bhatsai Project

Siemens India is a leader in Electrical Engineering technical know-how and has kept pace with the growing and complex needs of the Indian Electrical Industries.

We have considered our biggest manufacturing activities at Kalwa for the purpose of this Case Study of Labour Productivity.

Measurement of Performance and Productivity

Siemens India has its own scheme of measuring the Labour performance and productivity. The index used for payment of incentive is defined as

$$\text{P.I.} = \frac{\text{Gross Output (including Repair/Repeat work) in SMH}}{\text{Effective Input in AMH}}$$

$$\text{Productivity} = \frac{\text{Net Output (Excluding Repair/Repeat work) in SMH}}{\text{Total Input in AMH}}$$

SMH = Standard Man Hours.

AMH = Actual Man Hours.

The graphs in Annexure '1 & 1a' show the P.I. and Productivity of the 3 Manufacturing Units at Kalwa i.e. Switchgear, Switchboards and Motors.

Initially till the year 1975, the three units were functioning independently at different physical locations, when all the three units were brought together in one complex at Kalwa. In the city of Bombay the chances of expansion for these units being very less, there was always a shadow of being required to transfer the entire activity. The congestion in the available area, along with associated problems due to being seperate like lack of effective co-ordination of activities and communication did not permit a rising trend in productivity.

After all the units were brought together at Kalwa, problems owing to centralization from decentralized system of Working erupted. Each unit which existed as a separate entity having its own traditions, practices and inter-relationships lost its identity. The employees were also exposed to disturbances in their personal/social life because of change in work location, long travelling hours and change in work schedules. Re-organizing of various common functions resulting in centralization of Incoming Inspection, Receiving & Despatch, Maintenance brought to surface the different working styles followed. Added to this were the problems like communication difficulties with the city and vendor supplies position. The cumulative effect of all these was having an impact on the employees morale and consequently on labour productivity and industrial relations situation. This in the end resulted in inter-union rivalry which led to a partial strike of 10 months (Feb. 1978 to Nov. 1978). There was an improvement in the situation from late 1979 onwards with the majority of workmen backing the recognise union. The Management on its part was also trying hard to stage a reversion in the declining trend. Attention was concentrated on workmen at the centre of activity and emphasis was given on improvement of workplaces, various processes and methods were introduced which are explained in the following paragraphs :

Major activities of Productivity improvement on the shopfloor for optimum utilization of Manpower/Machine/Material (Input resources).

Improvement in deburring technique of plastic components.

Earlier Method :

Previously in our plastic shop for deburring the plastic components, shot blasting technique was used. The operator used to hold the part and turn it about in front of the fixed gun. This gun blasted coconut shells by means of compressed air on the plastic parts. The above process had the following drawbacks :

(a) As the part was to be manipulated in front of the gun by hand, it was causing fatigue.

(b) As the area in the shot blasting cabin was though lighted, relatively dark—it was strenuous for the eye.

(c) As the operation was manual and illumination lower, quality of deflashing was not consistency

(d) Operation was relatively slow.

The answer to the above was found in the new 'Isper Deburring Machine'.

New Method :

The machine consists of loading the parts through conveyor belt, rotating cylindrical tube of wire mesh and a collector. A turbine hurls the nylon granules at high velocity in a relatively wide are and at larger angles on the wire mesh tube through which components pass. This wire mesh tube continuously rotates along with the plastic components-inside. Thus all the surfaces of the components are subjected to the nylon granules jet treatment. There are also separating zones which separate Burr/Flash from the nylon granules. Addition of special anti-static chemicals to nylon granules ensure that the burr removed does not stick to plastic component.

Cost of implementation :

Rs. 4,00,000/—

lines in view, following recommendations were evolved to have shorter assembly lines

—Shorten the length of assembly line by regrouping various elements of the operations.

—Eliminate the jobs from the flow line which are are not connected directly with the end product.

—Effective working area.

Result of implementation :

—Faster and accurate work.

—Saving in the mannfacturing of jigs for drilling.

—Saving in material handling time.

—Saving in production time approximately 1,500 Hrs./Year.

—Saving cost of jigs Rs. 20,000/- per year.

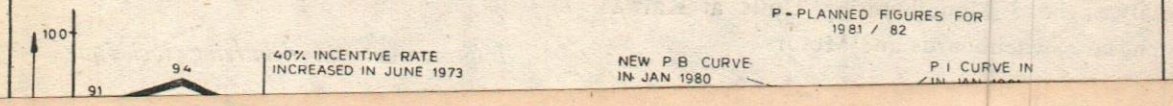
Performance Index %.

KALWA WORKS SIMENS INDIA LTD.

UNIT	70/71		71/72		72/73		73/74		74/75		75/76		76/77		77/78		78/79		79/80		80/81		81/82		82/83		COLOUR CODE
	L	EC	L	EC	L	EC	L	EC	L	EC	L	EC	L	EC	L	EC	L	EC	L	EC	L	EC	L	EC	L	EC	
WSGR	3.2	3.1	2.1	7.3	2.3	5.4	2.4	7.4	4.2	11.0	3.4	10.8	5.6	5.5	4.4	5.0	11.2	7.4	7.0	11.9	3.4	10.3	4.7	6.4	4.1	6.4	
WMOT	2.5	5.5	2.3	8.2	8.0	2.0	2.0	7.4	4.7	7.7	2.7	4.5	5.6	4.1	2.8	5.5	8.0	5.2	7.2	15.8	4.5	11.6	3.3	9.8	3.0	9.1	
WSWB	0.4	2.9	6.3	3.9	0.4	7.2	0.3	7.2	0.5	6.3	0.9	7.2	2.1	2.9	1.8	3.3	4.3	5.7	3.2	5.2	3.5	7.4	7.5	9.5	6.5	7.0	

EC - EXTRA COST, L - PLANNED + UNPLANNED IDLE TIME

P - PLANNED FIGURES FOR 1981 / 82



New Press Shop Concept in Motor Plant

New press shop concept for higher productivity incorporated following :

(a) Use of compound dies for stator lamination for electric motors.

(b) Use of pre-coated coils of silicon steel for laminations with decoiler and straighten

(c) Use of high speed notching press with tangential adjustment facility (skew formation) on rotor packet.

(d) Redesign of motor from LA3 to LA7 to give higher outputs from same motor size, rendering motor economical.

ACCIDENT STATISTICS
(Kalwa Works)

	1981-82	1982-83
Frequency Rate per 1000 Hrs.	4.02	2.85
Severity Rate per 100,000 Hrs.	20.6	16.3
Number of Accidents per 100 Workmen	5.7	4.9

	Reportable	Nonreportable
1980-81	175	129
1981-82	141	116
1982-83	119	121

Result of implementation :

	Saving in SMH	*Material Rs.*
Use of compound dies eliminated shift in each slot separately notched on stator blank. Compouud dies punched all slots in one storke and hence quality of lamination is improved and also considerable reduction in the standard time per piece. It also improved slot alignment and pupil insertion operation was don with ease and more productivity in winding shop.	4308	—
Use of pre-coated coils permitted us to use decoiler with an arrangement to load two coils so that when one coil is exhausted another pre-loaded can be brought in line. Coils of desired width reduced the wastage of material and inproved the productivity due to continuous feed mechanism operation line. Varnishing and slitting from sheets were eliminated.	3479	4,44,000
High speed notching press with Huber (skew) notching gave 60% higher output and also gave correct spiral on rotor, maintaining the performance characteristics of the motor.	840	—
Development of high voltage motors with a special design of internal, double ended air circuit cooling. We are developing 3.3 kV and 6.6 kV HT motor with superior and totally different cooling technology. With this cooling efficiency it is possible to offer motor to give higher output from same size rendering it more economical.	210	1,60,000
TOTAL	8827	6,04,000

3.2 Also following measures are taken to improve productivity

1. To reduce fatigue and achieve faster movements, use of various materials handling equipments like-Forklift, High Reach Truck, Tugger-trailors, Jib Cranes & Overhead Cranes, etc.

2. Introduction of conveyorised lines to reduce fatigue.
3. Use of vibratory feeders—to eliminate manual feeding.
4. Improvement in tools, press tools and Moulding dies, etc.
5. Use of new jigs, fixtures and templates, etc.
6. Use of raw material coils for automatic, continuous feeding.
7. Improved strip layouts for pressed parts to minimize scrap.
8. To improve material handling, standardization of bintrays and cage boxes, etc.
9. Use of vibratory feeders—to eliminate manual feeding.
10. Improvement of shop floor layouts by keeping adequate space for in process material and gangways.
11. Use of multispindle machines—for reduction in cycle time.
12. Introduction of various new technology machine like.

    —wire erosion machine

    —spark erosion machine

    —copy punching & shearing.

Similar to the above mentioned specific studies some further studies were conducted in dfierent units which resulted in reduction in process time, reduction in material cost, accurate and consistent quality output, elimination of physical discomfort to the workmen, reduction in delays, etc.

Improved Incentive Scheme

4.1 Siemens introduced an incentive scheme in 1964-66 and incentive payments were related to the start of the grade (Basic). But, by the end of 70's it was felt that incentive scheme was not at all effective due to

—improved financial benefits because of subsequent settlement on service conditions between Management and the Union.

—Improved total wages because of higher dearness allowance, due to inflation and thereby

—Substantial reduction in ratio of incentive earnings to gross wages.

To arrest the declining trend of productivity which was observed over a period of previous 10 years, a need was felt to modify such an incentive scheme. The incentive scheme was modified and introduced in Jan. 1980 as "Production Bonus Scheme" which considered the ratio of gross output to total input of the workmen barring allowable time, or restircted time allowable to workmen for Sports or Committee meetings etc. But, in the inputs of the workmen there was no provision to deduct the downtime due to want of material, machine breakdown, power failure etc. The effect of downtime on input was not taken into account with a philosophy that for such period of downtime the workmen are already paid the guranted/normal wages.

However, the rates of incentive payment were raised to such an extent that workmen at 100% Production Bouns Index, could get 31% of gross wages (Basic+DA+HRA) at the time of introduction of the revised scheme. The same scheme was discussed in the subsequent negotiations with the Union and became, for the first time, the part of the settlement of January 1981 as a joint responsibility to improve productivity. The only modification was the calculation of performance index formula to the extent of eliminating the effect of downtime observed in the previous formula.

At the time of settlement the maximum P.I. for payment of incentive was decided as 100%. However, on observing the rising trend of P.I., the maximum P.I. for incentive payment was raised to 120%.

The Scheme is applicable for both types of workmen i.e., workmen who are directly engaged on manufacturing activities (i.e., productive workmen) and those who render their services to the production activies i.e. material handling (Stores+Transport), Quality Control, Maintenence (i.e., Service workmen).

Formation of Incentive Committee

In the settlement it was agreed that maximising the efficiency for Productivity enhancement is a joint goal of Management and the Union. It was also agreed that the Union has right a to discuss the problem of production, material supply work norms and standard and so establishing a common forum was necessary, hence we have formed the Incentive Committee in each unit in which there are equal number of representatives from the Union and Management, with the objective of.

—establishing proper understanding

—general confidence

—increasing sense of participation between Management and workmen to make the Scheme a joint success.

A meeting is held every month and this has provided the workmen a channel to solve day-to-day shopfloor quarries/disputes regarding standard time, allowances, method changes incentive payments and the Scheme etc. The present Incentive Scheme has resulted in not only financial rewards, improved morale and higher levels of productivity, but has also generated a performance oriented style of working and productivity conciousness among the workmen. The average financial rewards through incentive for 82/83 of a productive workmen is Rs. 140/- per month.

Introduction of Suggestion Scheme

In 1979 with a view to generate constructive thinking amongst our employees and suitably reward them for useful suggestions, a Suggestion Scheme was introduced. This promoted greater involvement of the working people and helped to inculate the habits of participation in day-to-day working and increased cooperative feeling in the Company

Motivation through Suggestion Scheme

In order to involve and motivate the employees to give more suggestions which will improve

—Material Productivity

—Labour Productivity

following measures have been abopted :

(a) Publishing the photographs of the award winners and write-up about their suggestions in the House Magazine "Siemens Sansar."

(b) Distribution of special awards at the annual Dassera function by the Works Director to the best suggestor from each unit and the best from all the units.

A feedback in the form of various statistics is given to all the unit managers to take corrective action at their end viz,

1. Pending appraisals statistics—Monthly
2. Implementation of accepted suggestions—half yearly
3. Display of big posters giving various pictorial coloured statistics and publishing the name of the best suggestor from each unit.

Training/Educative Information Programme

Management of Siemens India realises the need for continuous training of their workmen, supervisory staff and even Managers to

—facilitate exchange of information.

—promote cost and productivity consciousness amongst the employed.

A number of in-house training programmes have been organised on subjects like Work Study, Incentives, Quality Consciousness by our internal faculty of Industrial Engineering and external agencies like NPC.

The main feature of all the in-house programmes is the concluding session of "MEET THE MANAGEMENT" in which Works Managers/Chief Managers of various Units and departments participate in an open dialogue. The participants in the "MEET THE MANAGEMENT SESSION" raise querries and they utilise this opportunities to get further clarifications from the Managers vis-a-vis applications of productivity techniques and concepts learnt during these programme.

Similarly, shopfloor personnel and officers are also

sponsored for the outside programmes/seminars/workshops organised by professional institutes and bodies such as NPC, NITIE, ASC, etc.

Over and above the training of its own personnel, the Company also believes in training the personnel of their clients/customers.

The training efforts of the Organisation have been steadily increasingly as seen from the table given below :

		1979-80	*1980-81*	*1981-82*	*1982-83*
Workers	No.	70	11	75	86
	Training days	349	93	341	805
	Total strength	2846	2907	2880	2895
Supervisors+ Staff	No.	62	24	38	67
	Training days	415	267	199	1445
	Total strength	659	699	665	675
Others	No.	16	6	31	65
	Training days	110	29	128	131
	Total Strength	155	182	190	206

Introduction of Industrial Safety Cell

To promote industrial safety and ensure safe working environment, a separate industrial safety cell has been created, and a full-time Safety Manager is appointed. The concept of safety everyone's responsibility is born in the minds of the workforce. Also line managers have been assigned additional responsibility for safety on shop-floor. Apart from the Central Safety Manager, the company has appointed 6 additional safety officers from line functions to strengthen the industrial safety concepts, to improve safety in all our workplaces and to reduce accident rates further. The company appointed 6 Safety Captains with a view to assist the Central Safety Manager in all aspects of Safety and accident prevention programme. The main activities of the Safety cell are :

1. Creating safety awareness in all the units.
2. Investigation and classification of accidents.
3. Publication of safety bulletin giving safety information and statistics.
4. Providing personal protective equipments (safety shoes, safety goggles, hand gloves, ear muff, etc.).
5. Organising Safety Training Programme.

This has resulted in reduction in accidents and man-hours lost which directly increase the availability of man-hours and contribute towards labour productivity.

Management by Communication and Objectives

In the earlier days, the employees of the Company were not aware of their performances, their company sales, developmental activities, their targets and achievements. With a firm opinion that the employees on being informed about market position, order position, problems before the management, and knowing how the management wants to overcome the situation can give their best; the culture of management by communication and objectives was developed with a view to :

1. *To share* Management's philosophy, policies and *objectives* so that it results in better understanding of Manacement view point as well as appreciation of market situation.
2. To share information about production, performance, sales, development activities in order to motivate employees to higher productivity and to have continued improvement in performance.
3. To promote more participation and co-operation between management and employees and the union and to maintain healthy and harmonious industrial relations.

The following means have been adopted for the same :

(a) General Assembly :

Unit-wise half-yearly general assemblies on the shop-floor addressed by the Works Director.

(i) to share general information about targets, achievements, production and productivity trends and

(ii) to convey management messages directly to the employees, whose questions are also answered on the occasion.

(b) Hoardings :

Monthly hoardings are exhibited giving details of monthly targets, objectives, performance and information on current topics etc., in order to

(i) support the productivity culture and

(ii) to increase employees' participation and co-operation for Suggestion Scheme and flexibility, etc,

(c) Banners :

Quarterly banners are exhibited on the shop-floor giving special messages, e.g., on joint responsibilities towards achieving higher productivity, or Quality improvements, timely deliveries, healthy work-place practices, etc., to the employee.

(d) Productivity News :

A fortnightly pamplet giving specific instances of improvements in productivity. Articles are contributed by employees. The intention is to expand the awareness and understanding of productivity of our employees and to increase their commitment to the rationalisation programme.

(e) Family Letter :

The Family Letter from the Works Director is addressed to all the employees and their family members and it covers subjects like targets, planned and achieved turnover, quality efforts, absenteeism its effect on productivity and situations in the Work, etc.

(f) Workshop :

Unitwise workshops to which groupleaders, foremen, Engineers, Officers and Managers are invited, are held annually to review achievements of the last year and goals for the next year. These workshops were in the past in the form of informal get-together. However, it has become a practice now to explain the objectives of the units, their achievements and seek the commitments of the working people in the unit.

Union—Management fortnightly meetings

Involvement of Management as well as Unions for increasing productivity are so interlocked that none can proceed far without the co-operation of the other. Therefore, regular periodical meetings between Union and Management are held to discuss cost reduction, improvements in manufacturing technology, Introduction of new products, informing about market situation, order position and also to get the involvement and commitment of Union.

All these measures like General Assemly, Hoardings, Productivity News, Family Letters etc., have created a tremendous impact on the morale of the employees. The responses to these have been very encouraging and the company hopes to have a real productivity boost in the house of Siemens.

The Measurement and Monitoring of Labour Productivity :

Siemens has developed quite a new useful criteria for measurement and monitoring of labour productivity. These criteria are reflected in the Management Information Systems Reports. This system is introduced to—

—facilitate timely corrective action by the Management

—for inculcating productivity—consciousness amongst the employees.

The reports prepared as a part of M.I.S., for performance monitoring are as mentioned below:

1. Unitwise/Shopwise Performance Analysis where monthly and progressive figures are shown for—

   (a) Performance Index
   (b) Productivity
   (c) SMH/Man/Month
   (d) AMH/Man/Month

(e) Unproductive hours

(f) Overtime hours

2. Monthly Standard Man Hours (SMH) against the planned SMH Output –Unitwise.
3. Monthly Low Performance Analysis—Unitwise. This is to identify the workmen whose performance level is below the performance achieved by 90% of the persons in the Units, so that corrective action can be taken knowing specific reasons for low performance.
4. Performance Distribution Curve—Unitwise Quarterly.
5. Monthly Absenteeism Report—Unitwise.
6. Unitwise Monthly Direct and Indirect payment Report for workmen.
7. Daily and Weekly Output Reports—Unitwise.
8. Average Monthly Incentive Earnings by Productive and Service workmen—Unitwise.
9. Charts, Diagrams, Graphs on the Shop-floor are displayed showing monthly figures e.g.

—Downtime

—Extra cost

—Quality Standards

—Efficiency

—Backlog

—Targets (monthly, weekly/daily and achievements).

These reports are helpful to employees in knowing the targets, the unproductive hours and assess the monetary benefits one can get through Incentive Scheme, etc.

Agreement Gains

9.1 In Jan. '81, Siemens India signed a settlement with the Workers Union and in April '81 with Staff Union, which further improved their service conditions remarkably and also gave substantial monetary benefits.

1. The main features of the workmen settlement :

A broad declaration of aims and objectives was made jointly by the Union and the Management. Both the parties agreed to emphasis on collective bargaining and to have regular cordial dialogue on the problems such as—

—Increase in Production/Productivity

—Saving of costs

—Improvement of working conditions

—Maintaining discipline

—Any other problem which might have direct/indirect effect on workmen.

2. Promotion Procedure :

Normally the Union insists a promotion for senior people as a philosophy to express their respect towards their experience. A definite procedure was formulated for promotions assessing individuals suitability for higher jobs. This takes into account their performance, seniority in the company and in the grade, qualification, training, attendance record etc. This is helpful to strike a balance between experienced-senior persons and qualified-young-capable persons.

3. Wage Grade Promotion :

In Siemens the promotions are based on vacancy concept and as per the job classification. Job classification is done based on skill, experience and knowledge required for the job. Growth rate of the company was gradual hence the promotion opportunity for majority of senior workers was reduced resulting in stagnation. In this wage grade promotion, it has been agreed that the workmen while continuning to perform the same job can be qualified to be promoted one wage grade higher provided his general record in the Company is good.

4. Retirement Benefits ;

To take care of the up-keep of the post-retirement life, the Provident fund, Gratuity Scheme were improved. To encourage savings joint saving scheme was lunched wherein the company handsomely contributed towards each employee's account. The employee joining the company around the age of 25 years, shall earn

by ambulance, Oxygen Cylinders for emergency.

Periodical medical check-up is conducted for people working in Canteen, Paint shops, Drivers, Galvanic, Watchmen, etc.

(f) Open House Day :

Family members of the employees are allowed to come and see the factory.

(g) Hobby Exhibition :

This is for family members and exhibition is held during Open House Day and prizes are awarded to the best three in each category thereby a chance is given the relatives of the employees to show their talent.

(h) Preeti Bhojan :

On the first working day of Fiscal year, Managers, Officers, Staff and Workmen take lauch together.

(i) Dassera Function.

Social gathering of all employees in the factory.

(j) Annual Athletic Meet and Sports Day :
In addition to Sports activities throughout the year for games like Volley Ball, Hockey, Cricket, there is an Annual Sports Meet—Sports day every year.

(k) Introduction of Marriage Gift from Management.

(l) Silver Jubilee Celebration/Retirement function :

(m) Blood donation campaign and Blood Bank with KEM hospital.

(n) Financial help to rural development.

(o) Financial assistance to employees through Credit Society.

(p) Picnics by employees are encouraged and given some subsidy.

(q) Marathi literary social—Sanskritic Manch which stages drama, speeches, symposia etc.

(r) Financial assistance to Local Village School.

(s) Housing Colony for essential staff.

Conclusions

Evaluation of Improvement in Labour Productivity :

Following table indicates for the past four years improvement in performance index and productivity :

	79/80	80/81	81/82	82/83	Improvement 79/80-82/83
Performance index %	52	66	82	84	+ 61.5%
Productivity %	45	56	69	70	+ 45.6%

When the improvement of performance level is achieved by workmen for the past three years is examined on "Distribution Curve" it is clear that there is a gradual upward trend.

Performance Range	Percentage of workmen		
	1980-81	1981-82	1982-83
Less than 45%	20	4	3
Bet. 45% and 65%	26	14	10
Bet. 65% and 95%	42	56	60
Above 95%	12	26	27
Total :	100	100	100

The effect of labour productivity on output in Rupees when compared with the previous year, on common base (i.e., excluding inflation) can convincingly be seen from the following table :

Year	Over the previous year		
	Real Growth	Manpower Growth	Recovery
1980-81	+20%	+1%	+21'4
1981-82	+20%	−1%	+27'3
1982-83	+ 6%	+1%	+14'2

The benefits accrued due to these improvements are being felt gradually but certainly—through the improvements in inflow of orders, basically because of maintenance of delivery promises. The productivity gains have largely contributed to our company's sound financial position. Of course these achievements could never have been achieved without the active participation, whole hearted cooperation extended by our Unions.

Productivity
1984, XXIV, 1, 115-117

EXECUTIVE READINGS

How to Fight Dirty Against Management

Joe Mancuso

Published by :
Jaico Publishing House, Bombay
Ashwin J. Shah
125, M.G. Road, Bombay-400 001
Year of Publication : 1980
Price : Rs. 25/.
pp. 221.

Reviewed by :
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Bhopal-462 016

The school for Scoundrel was an innocent American movie but this book is not. Instead, "How to Fight Dirty Against Management" is a case in favour of shirkers and incompetents not only advising them to become manipulators but also showing the way how to-do it.

If the contents of this book represents even partially the organisational culture in American commerce and industry, this book would evoke, to an Indian reader, a sense of perverse satisfaction by knowing that it is not only poverty and illiteracy which breed a class of shirkers and incompetents but the impact of affluence is also not much too different either.

In any case the book brings to the fore a known controversy as to whether the secret of success lies in the competence and hard work or in the dirty game of expediency and ingratiation. What is so far held as an axiomatic truth is that the manipulative behaviour may help an individual in achieving short-term gains but it is sheer competence and hard-work which would ultimately crown the person with overlasting success. Joe Mancuso would have done a yeoman's service to his readers if he would have carried out an empirical study to invalidate this truth.

It should, however, be a caution to the prospective readers of the book that it is neither a satire on the middle management for their dirty tricks nor a warning to the top management against them. Instead, the author is serious about the efficacy of the sordid games when he says that success "in today's multifaceted corporation is an uphill struggle—it takes courage, conviction and this book."

To the American middle managers for whom this book is written, I have a suggestion : after reading this book, if they believe in its contents, they should not think that they have qualified for the 'black belt.' Let them come to an Indian organisation for their real graduation in fighting dirty against management. To their Indian counterpart, I would say that this is a nursery book as their knowledge and practice about this game far exceeds the knowledge (I do not know about the practice) of the Author. Therefore, they will not miss anything if they escape its reading.

It appears that the tremendous 'Box Office' success of Northcote Parkinson and Lawrence Peter for producing Parkinson's law and Peter's principles has motivated

many others to follow their footsteps in dealing serious management issues with a lighter pen. However, most of them have failed to deal with the fundamentality of the issues that Parkinson and Peter dealt upon as also the crispness of their language which has given many quotable quotes to the readers. Joe Mancuso fails on both the counts. While the contents of this book are inversion of modern management concept and theories, his language is lacking the punch of a satirist or humourist. The printing and the get up of the book would have been passed as good if it would have been published ten years ago when photo setting was a rarity in India. In all, reading this book is like seeing a popular Indian crime movie.

Co-operative Marketing of Farm Products in Asia

Published by :
A.P.O.
4-14, Akasaka, 8-Chome, Minato-ku, Tokyo, Japan 107
Year of Publication : 1981
PP : 182

Reviewed by :
Mr. J.K. Jain
Director
National Productivity Council
11, Lady Curzon Road
Bangalore – 560 001

"Co-operative Marketing of Farm Products in Asia" published by Asian Productivity Organisation makes informative reading of co-operative marketing of Agricultural products in Republic of China, Hong Kong. India, Indonesia, Japan, Nepal, Korea Pakistan, Phillippines, Sri Lanka and Thailand.

The booklet is the result of a multi-country study mission sponsored by the Asian Productivity Organisation during 1981 to study the co-operative marketing of agricultural products in Japan and Korea. The participants of the mission drawn from these countries mentioned above have observed agricultural co-operative marketing structure, trends in co-operative marketing, Government policies and major problems of co-operative marketing and have given the first hand experience of South Korea and Japan, which is explained in Part I of the book. The part II of the publication gives factual data regarding co-operative marketing in various Asian countries covering the aspects of structure of co-operative assistance, the commodities covered Government policies towards co-operative marketing and major problem areas. The chapters have been written by eminent experts in co-operative marketing. For example, co-operative marketing of farm products in India has been written by Shri Indrajeet Prasad, the one who is directly connected with co operative marketing.

The book highlights the development of co-operative marketing in various Asian countries and also explains the problems faced by them. However, one noticeable drawback of this book is that it does not offer solutions to many of these problems. Had the book offered practical suggestions to overcome these problems, the book would have found more use for the persons directly dealing in the field of co-operative marketing. Inspite of this minor drawback, the book with its well structured and well presented data, will be an asset to all those in the field of co-operative marketing.

How to cut office costs
Harold H. Longman

JAICO Publishing House
Ashwin J. Shah
JAICO Publishing House
Bombay-23
1980 (Originally published in UK)
pp. 300

Reviewed :
A. Rajagopalan
Deputy Director
National Productivity Council, Madras

Communication is the nervous system of any organisation. Without proper communication system decision making and excution of decision become very defective and difficult. This is very seldom realised in practice and the tendency to consider communication and paper work as a "necessary evil" prevails. Attention given to this vital area of management the effectiveness of which decides the difference between a well managed and a badly managed organisation or rather between a successful and an unsuccessful one is very limited and publications on the subject are very few and far between.

It is in this context that this comprehensive book published

originally in UK and now by Jaico in India becomes a much needed and welcome addition to a business library.

Of specific relevence to the O & M practitioners are the pages dealing with the organisation and conduct of O & M studies, creative thinking, forms design and filling principles.

Paper work related to specific office areas like purchasing, financial and cost accounting, sales, personnel stores, production control are all dealt with in detail, section by section.

Common office operations like sorting, calculations, reproduction, forms control, checking of office work, office furnishing, filing etc. are analysed and various suggestions for streamlining these along with many shortcuts and ready made solutions and handy gadgets are suggested. These should come in handy for managers in rectifying problems in office quickly.

Written in easy and readable style ths book should be of use to O & M Experts and all supervisors and executives, who have to manage paper work and achieve office productivity.

Guide to Disciplinary Action
Datta, S.K.

Published by :
Bankers Training College, Reserve Bank of India, Bombay
Year of Publication: 1983
Price Rs. 22.00
pp : 162

Reviewed by:
Dr. (Ms.) Mani. K. Madala
Sr. Consultant, National Productivity Council, New Delhi

The present book is intended to be a handy reference material for managers, executives and also the students, on the various facets of the subject of discipline. In an orderly sequence it presents both the conceptual and applied aspects of discipline and discusses the procedural formalities with relevant case law. Discipline is a sensitive area. Many major industrial relations problems often emanate from this. The protective legislation, makes administering discipline a difficult task. The book is a timely contribution in turbulent state of industrial relations in the country. In 19 chapters the book discusses the concept of discipline, the approaches to it, measures to prevent in discipline, principles of natural justice misconduct, charge sheet, suspensions the process of and rules regarding enquiry statutory obligations with regard to punishment and appeal. The book devotes one chapter to a discussion on disciplinary procedures for government servants, for many public enterprises draw their inspiration from them. One can see that a lot of work has gone into the making of this book. The book is a must for all managers. Attractive get ups fairly priced.

OUR PERIODICALS

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Carries informative articles and interesting features aimed at the development of workers and supervisors to propagate the concepts, approach and methods of productivity. Progressive employers and management can utilise this organ for education and development of their employees through subscribing for bulk copies for large scale distribution.

Annual Subscription : India : Rs. 6.00
Foreign : 3 US Dollars

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Select Bibliography on Productivity Measurement

S. N. VIG

GENERAL

American Management Association Meeting the productivity challenge, New York, A.M.A., 1960, 102 p.

Asian Productivity Organisation : Fourth Workshop meeting of directors of Productivity Centres, Japan, A.P.O., 1964, 153 p.

Asian Productivity Organisation : Industrial Relations and Productivity in Japan No : 26. Tokyo, A.P.O., 1971. 108 p.

Asian Productivity Organisation : Study report on productivity drive programme planning and coordination, Tokyo, Asian Productivity Organisation 1962. 79 p.

Backman (Jules) *Ed.* : Labour Technology and Productivity in the seventies, New York, New York University Press, 1974. 144 p.

Beesley (Michael) *Ed.* : Productivity and amenity : Achieving a social balance, London, Croom Hehn, 1974, 135 p.

Bergson (Abram). : Productivity and the social system; the USSR and the West, Massachusetts, Harvard University Press, 1978, 256p.

Bhattasali (B.N) & Bhattasali (G. Miss) : Productivity and Economic Development, Tokyo, A.P.O., 1972, 121 p.

Bhattasali, BN & Battasati, G : Productivity and Economic development, Tokyo, Asian Productivity Organisation 1972, 121 R $4.50.

Bombay Productivity Council Seminar on higher productivity through building insulation, Bombay, BPC, 1967, 78 p.

Bradt (A. Gordon) : Five keys to Productivity and profits. New York, Parkar Publishing Co. 1973, 215 p.

British Productivity Council : Better ways—nineteen parts to higher productivity. London, BPC, 1959, 97 p.

British Productivity Council : Communications in Industry. London, BPC, 1960, 16 p.

British Productivity Council : Why productivity ? London, BPC, 1954, 16 p.

Brown, M : On theory and measurement of technological change, Cambridge University Press, 1966.

Butterworth, J : Productivity Now Oxford, Pergamon, 1968, 160 p.

Cummings (Thomas G) & Molloy (Edmond S) : Improving Productivity and the quality of work life. New York, Praeger Publishers, 1977. 305 p.

Datar (BN) *Ed.* : Productivity agreements, Workers motivation and sharing the gains of productivity, Tokyo, A.P.O., 1976, 114 p.

Delhi Productivity Council Souvenir national convention on productivity. Delhi, Delhi Productivity Council, 1976, 102 p.

Denison, EF : Why growth rates differ : postwar experience in nine western countries. Washington, Brookings Institution, 1967.

Dunlop (John T.) & Diatchenko (V.P) : Labour productivity. New York, McGraw-Hill, 1964, 409 p.

Durgesh Chandra : Dynamics of Productivity. New Delhi, South Asian-Publisher, 1980, 258 p.

Edwards, Ronald, & Roberts, RDA Status, Productivity and pay: A Major Experiment, London, Macmillan, 1971, 456 p.

Fabricant, Solomon : A primer on Productivity, New York, Random House, 1969, 206 p.

Fair, Ray C : The Short-Run Demand for Workers and Hours Amsterdam, North-Holland, 1969, 225 p.

Fallon, Carlos : Value analysis to improve productivity, New York, Wiley, 1971, 359 p.

Faraday (J.E) : (The) Management of Productivity. London, BIM, 1971, 81 p.

Felner, W : Appraisal of the Capital-Saving & Labour saving, Character of Innovations, The Theory of Capital, Macmillan, London, 1963.

Flanders, Allan : The Fawley Productivity Agreements : A case Study of Management and Collective Bargaining, Victoria (Australia,) Faber & Faber, 1966, 360 p.

Fuchs, Victor R. (Ed.) : Production and Productivity in the Service Industries. Studies in Income and Wealth, Vol. 34, by the Conference on Research in Income and Wealth, New York, Columbia University Press, 1969, 395 p.

Gaalhon, AL : Economic productivity in Israel. New York, *Praiger* 1971.

Gellerman (Saul W) : Motivation and Productivity. Bombay, DB Taraporevala, 1968, 304 p.

Griliches, Z : Notes on the Measurement of price and Quality Charges in Models of Income determination, Princeton University Press, NBER, 1964, 381-404 p.

Harlow (Chris) : Innovation and Productivity under nationalisation first-thirty years. London, George Hllen & Unwin, 1977, 256 p.

Ha rtmen, Paul T : Collective bargaining and productivity. The Long-Shore Mechanisation Agreement, Los Angeles, University of California Press, 1969, 307 p.

Heapon (Herbert) : Prodctivity in service organizations : Organizing for people. New York, McGraw-Hill, 233 p.

Hornbruch (Frederick W) : Raising Productivity : ten case histories and their lessons. New York, McGraw-Hill, 1977, 339 p.

Hinrichs (John R) : Practical management for productivity. New York, Von Nostrand Reinhold Co., 1978, 192 p.

International Labour Office : Measuring Labour productivity Geneva, ILO 1969, 172 p.

International Labour Office : Methods of labour productivity statistics. Geneva, ILO, 1951, 136 p.

Kendrick (John W.) : Productivity trends in the United States. Princeton, Princeton University Press, 1961, 630 p.

Kendrick (John W.) : Understanding Productivity : an introduction to Dynamics of productivity change. Baltimore Johns Hopkins University Press, 1977, 141 p.

Lie (Kwan H) : Productivity and Economic Growth, Tokyo, A.P.O., 1971 214 p.

Mali (Paul) : Improving total productivity. New York, John Wiley, 1978, 409 p.

Melman (Seymour) : Decision-making and productivity. New York, John Wiley, 1958, 260 p.

Nadkarni (GA) : Performance Productivity and profit improvement : a consultants approach, Bombay, G.A. Nandkarni, 1976, 793 p.

Nakayama (Ichiro) : (An) Introduction to productivity, Tokyo, Japan Productivity Centre, 1963, 50 p.

National Economic Development Council—London Productivity Prices and Incomes a general review 1967. London, HMSO, 1967, 46 p.

National Productivity Council: Impact of productivity : a collection on cases, New Delhi, National Productivity Council 1964, 70 p.

National Productivity Council Seminar on (1) Co-operation for higher productivity (2) sharing the gains of productivity New Delhi, NPC, 19-23 p.

National Productivity Couucil : Sharing the gains of productivity. New Delhi, NPC, 1967, 46 p.

National Institute for Training in Industrial Engineering. *Camp.*: Report of a Research project on wage Productivity Correlation. Bombay, NITIE, 1971.

Nayar. GK & Marandu, DM : Measurement of productivity. Dares Salaam, National Institute for Productivity, 1969.

Nelson RR : Aggregative production functions and Economics Growth policy, in the Theory and Empirical Analysis of Production, *NBER*, 1967.

North (Dt. B) & Buckinghan (GL) : Productivity agreements and wages systems. London, Gower Press, 1969, 262 p.

Numerical control society, Anaheim : Opening door to Productivity and profit; proceedings. Anaheim, NCS, 1971, 486 p.

Organisation for European Economic Co-Operation *PUB.* Inter-firm comparison : an incentive to productivity, Paris, OEEC, 1957, 352 p.

Organisation for Economic Co-operation & Development : Productivity and Economic Planning. Paris, OECD, 1970, 323 p.

Pack, Howard: Structural Change and Economic Policy in Israel. London, Yale University Press, 1971.

Paige, Deborah & Bombach, Gottfried : A Comparison of National output and Productivity of the United Kingdom and the United States, Paris, OECD, 1959.

Pennathur, K : About Productivity, Delhi, National Productivity Council, 1966, 24 p.

Pennathur (Krish) : Productivity is for you too, New Delhi, National Productivity Council, 1966, 130 p.

Productivity Promotion Council of Australia, Productivity : the way ahead book 1—Goals and Barriers. Australia, P.P.C.A. 1972, 88 p.

Productivity Promotion Council of Australia, Productivity : The way ahead. Book-2. Human resources, Australia, PPC, 1972, 88 p.

Productivity Promotion Council of Australia, Productivity : The way ahead book-3. Management. Australia, PPCA, 1972, 81 p.

Productivity Promotion Council Australia *Pub.* Productivity : the way ahead; book 4 : Distribution and Technology. Australia, PPC, 1972, 90 p.

Ramachandran (N) *& others* : Role of Productivity in Asian Economic Growth. Tokyo, A.P.O., 1970, 186 p.

Ross (Joel E) : Managing Productivity. Reston, Publishing Co., 1977, 191 p.

Salter (W.E.G.) : Productivity and technical change. London, Cambridge University Press, 1960, 198 p.

Salter, W.E.G. : Productivity and Technical change with an Addendum by REDDAWAY, W.B. Cambridge, Cambridge University Press, 1969, 220 p.

Saxena, AN : Horizons to productivity. Delhi, National Productivity Council.

Shapiro (ELI) & white (W.L.) *Eds.*: Capital for Productivity and jobs. New Jersey, Prentice-Hall, 1977, 203 p.

Shaw (John C.) : (The) Quality—Productivity, Connection in Service sector management, New York, Van Nostrand Reinhold Co., 1978, 143 p.

Shrivastava (O.S.) : Economics of wages, Productivity and Employment. Gwalior, Kailash Pustak Sadan, 1968, 257 p.

Smith, IAN G : The Measurement of Productivity : A system approach in the context of productivity agreement. Gorver Press, 1973.

Staley (John D.) & Delloff (Irving A) : Improving individual productivity. New York, A.M.A. 1963, 207 p.

Stein, H & Nark, JA : The meaning and measurement of productivity. Washington, *Bureau of Labour Statistics*, 1971.

Steiner (Ivan D) : Group process and productivity. New York, Academic Press, 1972, 204 p.

Stettner, N : Productivity Bargaining and Industrial Change, Oxford, Pergamon, 1969, 204 p.

Stigler G : Economic Problems in Measuring Changes in Productivity, in Output, Input and Productivity Measurement, Cambridge, Mass, Aarnard University Press, 1966.

Strong (Earl P.) : Increasing office productivity A seven-step program. New York, Mc-Graw-Hill. 1962, 287 p.

Suri (G.K.) Productivity, wages, and Industrial relations, New Delhi, Affiliated East-West Press, 1976, 144 p.

Sutermeister (Robert A) : People and Productivity, *edn.* 3 New York, McGraw-Hill, 1976, 475 p.

U.K. National Economic Development Office Productivity : a handbook of advisory services, London, H.M.S.O. 1967, 123 p.

Wallis (S.Allen) : Progress inflation : Wages, Productivity and Prices. New York, N.I.C.B., 1960, 67 p.

Zaleznik, A etc. : Motivation, Productivity and satisfact on workers, Boston, Harvard Business School, 1965, 442 p.

Organisation for Economic-Co-Operation and Development (OED). Productivity in the wholesale Trade, Project No. 153 (Paris, European Productivity Agency, 1956)

Productivity measurement : A symposium for the seventies. International Publishing Service. 1971. United States Congress, Joint Economic Committee: Prductivity Prices & Incomes (Washington. D.C. 1967).

AGRICULTURE

Abraham, TP : Output Responses to Inputs and Yardsticks of Production in Agriculture. Seminar on Indian Agriculture Problems and Prospects. Delhi, Agriculture Economic Research Centre, 1966.

Baldev Singh Capital Formation in the Agriculture Sector in Haryana. Unpublished Ph.D Thesis, Dept. of Economics, University of Kurukshetra, 1972.

Bardhan PK Technological Change and Distribution of Gains in Indian Agriculture. Delhi, Institute of Economic Growth, 1975.

Brown DD : Agriculture Development in India's Districts, Harvard University Press, 1971.

Chaudhri, DP : Education and agricultural productivity in India. A thesis submitted to University of Delhi, 1968.

Dharam Narayan : The Impect of Price Movement of Area under Selected Crops in India, 1900-1939, Cambridge University Press, 1965.

Easter KW : Regions for Indian Agriculture Planning and Management, Ford Foundation (Memo) 1972.

Evenson RE : Labour in the Indian Agriculture Sector New Haven, Yale University (Memo) 1972.

Evenson RE & Jha D : "The Contribution of the Agricultural Research System to Agricultural Production in India." Indian Journal of Agricultural Economics, Dec. 1973.

Mukhopadhyay SK ; Sources of Variation in agricultural productivity. Delhi, Macmillan, 1976, Rs. 40.

INDUSTRY

Abernathy (William J.) : (The) Productivity dilemma : Roadblock to innovation in the automobile industry. London, Johns Hopkins, 1978, 267 p.

Asian Productivity Organization *PUBR* : Productivity through consultancy in small industrial enterprises. Tokyo, APO 1974. 503 p.

Balhotra, AS & Others : Impact of productivity services in small scale industries, part 1, Delhi. National Productivity Council.

Balkrishna, R : Measurement of productivity in Indian Industry. Madras University Press, 1958.

Banerji (Asit) : Capital intensity and Productivity in Indian Industry. New Delhi, Macmillan, 1975. 166 p.

Beri (G.C.) : Measurements of production and productivity in Indian industry. Bombay, Asia Publishing House, 1962, 177 p.

British Productivity Council : Cutting costs for productivity : Work-Study, Production control, Costing, quality control, variety production, shift work & team approach. London, BPC, 1958, 75 p.

British Productivity Council : Raising productivity in smaller firms. London, BPC. 28 p.

Bureau of Public Enterprises : Towards higher productivity : Report on seminar on higher productivity in public sector production enterprises, New Delhi, Secretary standing conference of public enterprises, 1976, 250 p.

Carter, CF, Reddaway, WB & Stone, Richard : The measurement of production movements. Cambridge University Press, 1965.

Chetty, VK : International comparison of productivity functions in manufacturing. NY, Columbia University, 1969.

Chinchankar (PY) : Wages & productivity in Indian Industries. Bombay, Vora & Co., 1969, 62 p.

Dharam Narain & RD Dhawan : Productivity Trends in the Indian Sugar Industry, Institute of Economic Growth, University of Delhi, Delhi, 1965

Economic & Scientific Research Foundation : Productivity, wages. and prices in Indian Industry 1953-1963. New Delhi, Economic & Scientific Research Foundation, 1968.

Eilon, S & Gold, B : Applied productivity analysis for industry. Pergamon Press, 1976.

Fuchs, Victor R : Productivity trends in the goods and service sectors 1929-1961 : a preliminary survey. National Bureau of Economic Research, Occasional Paper No. 89, 1964.

Galloway, DF : Technology, Economy & Philosophy in improving productivity in manufacturing industries, Delhi, National Productivity Council.

Ganguli (HC) : Industrial productivity and motivation a psychological—analysis, Bombay, Asia Pub. 1961. 92 p.

Goel, VK & Nair, NK : Productivity trends in Cement industry in India. Delhi, National Productivity Council, 1978, Rs. 60.00, 156 p.

Goel, VK & Nair, NK : Productivity trends in cotton textile Industry in India. Delhi, National Productivity Council, 1976. Rs. 40.00, 48 p.

Goel, VK & Others : Productivity trends in iron and steel Industry in India, Delhi, National Productivity Council, 1974, Rs. 20.00, 76 p.

Habibullah (M) : Some aspects of Productivity in the Jute Industry of Pakistan. Dacca, Bureau of Economic Research, University of Dacca. N.D. 180 p.

Hildebrand, GH & Lih. J : Manufacturing Production Functions in the U.S., 1957. An inter industry and inter-state comparisons of Productivity, Ithaca, New York University, 1965.

India Commerce & Industry (Ministry of—) : Report of the Indian Productivity delegation of Japan. New Delhi, Ministry of Commerce & Industry, 1957, 158 p.

India ; Productivity Centre : Productivity project in small scale industries—Hyderabad. Bombay, IAB. 1960.

Indian Statistical Institute, Calcutta : "Trends in Productivity in Indian Manufacturing Industries. 1946-1958," Indian Statistical Institute Working paper No. PDEAV/164(300).

International Labour Organisation : Productivity in Coal Mines. I.L.O. Geneva, 1951, 177 p.
(Coal Mines Committee, Fourth Session)

International Labour Organization : Factors affecting productivlty in the metal trades I.L.O. Geneva 1952, 116 p.

International Labour Office : Report to the Government of India on a productivity mission. Geneva, ILO, 1955, 65 p.

Kendrick, JW : Postwar productivity trends in the United States 1948-1969. National Bureau of Economic Research (General Ser. No. 98), 1974.

Kendrick, JW : Productivity trend : capital and labour. Kraus Repr., 1956.

Kendrick, JW : Industrial composition of income and product. (Studies in income & wealth service. Vol. 32), National Bureau of Economic Research, 1968.

Kendrick, JW : Productivity trends in United States, Princeton University Press, National Bureau of Economic Research, 1961.

Krishna, KL : Production Relations in Mfg. Plants—An Exploratory Study, (unpublished Ph.D. Dissertation), University of Chicago, 1967.

Kux, J : Methodological problems of international comparison of levels of labour productivity in industry, New York, United Nations Economic Commission for Eourpe, 1971.

Lal, BB : Industrial productivity and economic growth. Allahabad, Chaitanya Pub. House, 1965.

Luthar (MM) : A practical approach to increasing productivity in engineering workshops. Bombay C.R.C. & WW, 19 N.D., 90.

Mehta (MM) : Measurement of industrial productivity. Calcutta, The World Press, 1955, 98 p.

Melman (Seymour) : Dynamic factors in industrial Productivity. New York, John Wiley, 1956, 238 p.

Mitchell, EJ : An econometric study of international and inter-industrial differences in labour productivity. California, Rand Corp., 1966.

Monga, RC & Saroan, JS : Impact of productivity services in small-scale industries, part III, Delhi, National Productivity Council.

Munshi, MC : Industrial efficiency, Bombay, Vora & Co., 1953.

Narain, D & Dhawan, BD : Productivity trends in the Indian sugar Industries. Delhi, Institute of Economic Growth, 1965.

Pratten (CF) : Labour productivity differentials within international companies. Cambridge, Cambridge University Press, 1976, 118 p.

Rakesh Kumar & Others : Impact of productivity services in small scale industries, part II, Delhi, National Productivity Council.

Satyanarayana (J) : Incentives and Productivity in Public enterprises, Bombay, Popular Prakashan, 1974, 153 p.

Sharma, S : Productivity in road transport Delhi, Assoc. State Road Transport undertaking, 1976.

Sibson (Robert E) : Increasing employee productivity, New York, American Management Association, 1976, 210 p.

Sinha, JN & Sawhney, PK : Wages and productivity in cotton textile industry in India. Delhi, Institute of Economic Growth, 1968.

Sinha, JN & Sawhney PK : Wages and productivity in selected Indian industries, Delhi, Vikas, 1970.

Suri, GK : Productivity, wages and industrial relations, Delhi, East West Press, 1976.

Letter from the Editor-in-Chief

Dear Reader,

Industrial scenario globally is characterised by expansion of industries, new technology, growing competition, and changing cultural and socio-political environment. Modern enterprises for their survival and growth, have to visualise a long term future, utilise the opportunities and contend against the threats of environment, to articulate the objectives and goals. In this process Corporate Planning has emerged as a powerful tool to help organisations to cope with environmental threats to overcome future uncertainties.

The recessionery trends in recent years have seriously affected the economies all over the world. Even among the developed countries the only country which could counteract the effects of recession was Japan and this was due to the high level of productivity in Japanese economy backed by innovation and introduction of new technologies through systematic and careful corporate strategic planning.

Since Planning is important and has to be given high priority in developing countries which suffer from scarcity of resources, it is equally important that in the execution of targets constant monitoring through strategic planning is carried out particularly in areas where demand for resources is far greater than their availability. Only through proper allocation of resources and gearing up of immediate needs and creation of infrastructure facilities, achievement of targets within a time frame (which is most crucial) can be possible.

As a result of massive investment in our Five Year Plans which has been substantially increased in the 7th Five Year Plan with emphasis on Food, Work and Productivity, the need for corporate planning at the national and organisational level has become even more important. Unless our investments generate surpluses and plough back the same for rapid economic growth the organisations will not be able to achieve the desired growth.

A major aspect of planning process is the need to establish inter-linkages between technology, human resource and productivity. It is equally important to compare achievements in one enterprise with averages at the sectoral level since this alone could identify the gap in specific areas and provide a sound basis for formulating a long term strategy. To emphasize this point, one might take into account the fact that if there is a big gap in technology it will indicate the need to either acquire or adapt new technologies available elsewhere or to update or modernise the existing technology which could lead to a reduction in cost of production and make the organisation viable and competitive in the market. In achieving this objective, the organisations will have to further evaluate the long term investment decisions and take recourse to Corporate Models available and evaluate the same with investment decisions to assess the impact on the achievement of corporate objectives. Another important aspect of corporate

planning which is likely to assume serious proportions in the near future is the fast development of technologies and less than adequate availability of professionally qualified and skilled manpower. As such in the overall strategic planning, human resource development can no more remain a device of soft pedalling or an activity which could be subservient to technology development. It will have to be regarded as an overriding factor for organisational growth and development. The experience so far gained has been that corporate strategy in the sphere of proven technologies can help managements to go in for right type of product market combinations to generate market attractiveness which cannot be achieved without cost effectiveness and improved quality of products, their design and acceptability. Consumer consciousness, competition in the items of consumption and development of buyers market have further hightened the need for production of goods and services which are of required quality and cost.

In India as a nation we have several strong areas and it is not as though we are far behind. In many areas we are even ahead. However, owing to traditional methods and usage, the application of corporate strategic planning has so far not attracted that importance which it ought to be given. It is only in the recent past that at the national and at organisational levels, there is a growing realisation that Corporate Strategic Planning is not merely a device or a tool but an important resource for managerial effectiveness and sustained growth of enterprises. If this is pursued systematically at all levels, the progress which we wish to achieve, will become faster.

(DR. A. N. SAXENA)