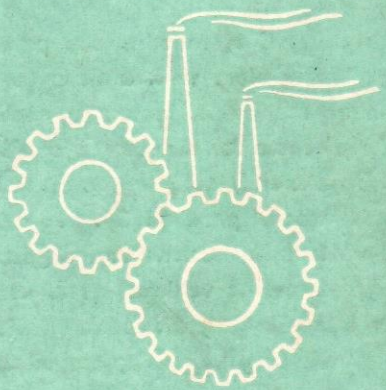
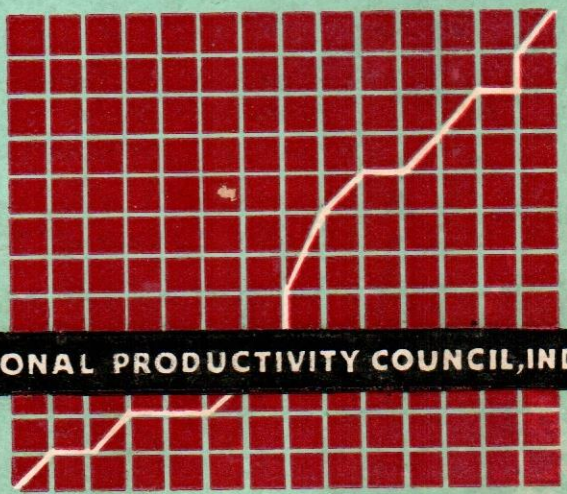
PRODUCTIVITY

VOL. 1 No. 2 DEC 1959—JAN 1960

JOURNAL OF NPC





NATIONAL PRODUCTIVITY COUNCIL, INDIA

NATIONAL PRODUCTIVITY COUNCIL

The National Productivity Council is an autonomous organisation registered as a Society. Representatives of Government, employers, workers and various other interests participate in its working. Established in 1958, the Council conducts its activities in collaboration with institutions and organisations interested in the Productivity drive. Local Productivity Councils have been and are being established in industrial centres.

The purpose of NPC is to stimulate productivity consciousness in the country and to provide services with a view to maximising the utilisation of available resources of men, machines, materials and power; to wage war against waste; to help secure for the people of the country a better and higher standard of living. To this end, NPC collects and disseminates information about techniques and procedures of productivity. In collaboration with Local Productivity Councils and various institutions and organisations it organises and conducts training programmes for various levels of management in the subjects of productivity. It has also organised an Advisory Service for industries to facilitate the introduction of productivity techniques.

NPC publications include pamphlets, leaflets and Reports of Productivity Teams. NPC utilises audio-visual media of films, radio and exhibitions for propagating the concept and techniques of productivity. Through these media, NPC seeks to carry the message of productivity and to create the appropriate climate for increasing national productivity. This Journal is an effort in the same direction.

The Journal bears a nominal price of Rs. 1.50 per issue and is available at all NPC offices. Annual subscription (Rs. 9.00 to be sent by cheque in favour of National Productivity Council, New Delhi) is inclusive of postage !

Page

1 PHILOSOPHY OF PRODUCTIVITY

3 "ARE PRODUCTIVITY TECHNIQUES EXPORTABLE?" .. HOWARD E HOUSTON

7 PRODUCTIVITY & INDUSTRIAL MEDICINE .. H P DASTUR

18 EXPERIMENTS IN PRODUCTIVITY

25 BUDGETING IN THE SMALL PLANT

29 THE NPC

37 NATIONAL PRODUCTIVITY PROGRAMMES

41 LABOUR PRODUCTIVITY IN SPINNING .. T V RATNAM & V RAMAKRISHNAN

50 CHOICE OF TECHNOLOGY IN INDUSTRIAL PLANNING .. JAN TINBERGEN

"....Nowadays when one talked about defence production and the like, one had to deal with technicians, experts, scientists and engineers more than with officers who commanded troops in battle. A new type had come up. It was this new type that was emerging in the army — competent technicians, competent engineers taking charge of production. Kanpur and Bangalore.... were humming with activity. May be when one hummed a lot, mistakes were made....Technicians and engineers should learn to take risks, risks of even making mistakes because we have arrived at a stage when every man with ideas, whether in the civil side or otherwise, is afraid....

"....if the United States and Russia were today strong, it was not because of their ideologies but because of their superior production methods."

JAWAHARLAL NEHRU

Philosophy of Productivity

A STAGE has arrived in the productivity movement, when further progress would be accelerated by the development of an adequate philosophy. There have been and continue to be a lot of lectures, seminars, conferences, articles in periodicals etc., where the word 'productivity' is being uttered, at times a bit too much, and sometimes a little too often. But it is an established fact that the word has "caught". Even small towns with hardly much of industry or industrial consciousness are asking for the establishment of local productivity councils. Thus the soil is ready for planting; and if we want a good crop, the first essential is the selection of sound seeds, well treated and seasoned for drilling at appropriate points in a fairly well prepared soil.

In this country there is an ancient tradition of viewing things in philosophical terms. It is difficult to understand this philosophical attitude in terms of Anglo-Saxon realism which is the chief responsible cause of higher levels of industrial productivity in countries of the West. A realistic, scientific attitude to life and to social affairs is the first ingredient in the cure of 'unproductivity' attitudes that have enveloped the countries of Asia for ages past. We need in the first instance a correct and sound philosophy in terms of the realities of the social and economic situation in Asia.

The concepts current about productivity appear to be somewhat narrow. To the employer, productivity means lower and lower costs. To the employee it means harder and harder work; and, therefore, less and less real wage for work of equal intensity. Probably this idea of productivity persisted due to the early experiments in productivity. Later experimentors in productivity who had the benefit of combining in their intellectual framework quite a number of disciplines including economics, social psychology and sociology came to a somewhat different conclusion, namely, that the first essential was to treat a human being as a human being, to make him feel that he was human with all the rights and privileges involved, that his values were final, that he was as much entitled to the elementary comforts of life in terms of food and drink, seating and lighting arrangements and the like as any other person, with his own personal experience, valid in its own right; and to disregard it was a serious violation of the fundamental canon of productivity. Such, for example, were the Hawthorne experiments in which a group of girls decently treated and respected and considered important in their own way, went on increasing their productivity, even though towards the concluding stages of the experiment, facilities were not added but withdrawn. This has been referred to by a distinguished veteran of the Tata's, Dr. H P Dastur, whose powerful article on Productivity and Indus-

trial Medicine, born out of long and deep experience, appears elsewhere in this Journal.

Even the army tradition has changed with the realization that a soldier, in order to fight courageously and with all his intelligence and skill, need not be subjected to boiling experience. Similarly, in industry, the idea that unless the foreman shouted at and abused the worker, the latter would not work, or would not work as hard, is outdated. All these ideas are against the fundamental tenents of productivity. A better treated worker, a better educated worker, a more comfortably placed worker who does not pass his time in anxiety about his security and the security of his family, his home and his food is a more productive worker than one who has not had these advantages, and the higher productivity of the worker pays for the advantages that lead to higher productivity. A productive economic system thus is a self-sustaining system. The whole concept of productivity needs to be viewed against this philosophical and social background.

It is this philosophical clarity that will lead to an acceptance by the working class of the whole idea of productivity, now mixed up with ideas of exploitation by the introduction of techniques which by some means or another knock out more out of the worker than otherwise. A productive technique is one which gives the worker the best of surroundings, that which puts him in a freedom of mind for work, that carries to him a *bona fide* conviction that the whole business of productivity is for his benefit and for the benefit of the society in which he lives and works. The sharing of the gains of productivity thus is not to be viewed in a limited manner, as to how the reduced costs are to be shared as between the employer, the consumer and the worker, but in the light of a broad conviction that the productivity of the entire system and of the individual unit in which a worker works is to the worker's own benefit. He should be made to feel that even if the management gains, that improves its capacity to offer him secure and more profitable employment; for it enables the management to invest in equipment, in skills that make work easier, pleasanter and more harmonious.

Summing up, it has to be said in the clearest possible terms that productivity does not necessarily mean harder work; it may actually mean less or pleasanter work done in surroundings not only of comfort but of group solidarity and fellow-feeling. These points need to be emphasized in this country because the peoples of Asia having passed through historical decades of grinding poverty have come to look suspiciously upon the introduction of new techniques, as somehow designed to get more out of them than to give them.

The whole task of increasing productivity needs to be viewed in a spirit of humility, for the task is stupendous. Productivity techniques have yet to be evolved from within the Indian experience. This country has plenty of talent. Even the specialised talent needed for the evolution and application of productivity techniques is taking shape. The prospect is pleasing but we have to work hard and religiously.

"Are Productivity Techniques Exportable?"

HOWARD E HOUSTON*

THE question which is the subject of this article is one which has arisen frequently in connection with programmes, such as that of the National Productivity Council, in which the International Cooperation Administration and other US Government agencies have assisted foreign countries in the planning and implementation of organized efforts to promote productivity or industrial efficiency improvement.

Productivity factors are here dealt with in the broadest sense, including not only detailed operating techniques of Management and Industrial Engineering but also such intangibles as Labour-management relations, the dynamic influence of competition, recognition of the public service responsibilities of industry, and emphasis upon large volume and low unit profits in marketing and pricing policy. The charge has been frequently made that it is foolish to assume that industrial concepts and methods which have been successful in the United States can be usefully applied in foreign countries. In the administration of these programmes of productivity assistance, we ourselves had doubts in the past as to their utility. The experience of conducting such operations since 1948 now gives us considerable assurance, however, with respect to these doubts.

Those who question efforts to assist in the economic development of their countries through the introduction of "productivity" ideas, attitudes and techniques from abroad often are sincerely concerned about the validity of such efforts. They are impressed by the differences between the economic and cultural conditions in their own countries and in the United States. They find many of the proposed ideas and techniques contrary to the established value structure of their own society. Even if they believe that the introduction of the new concept would be constructive, they regard it as impossible and regret the waste of energy and resources involved in what they consider to be a fruitless effort. Generally, however, the reaction is typically that of members of older and more mature societies who feel that it is the height of presumption and *naivete* for westerners, particularly Americans, to attempt to introduce *their* methods and ideas into other countries.

While we are well able to understand that American assistance to programmes such as that being conducted by NPC could be so viewed, we do not feel that this criticism is justified. In the first place, we only assist at the specific request of the cooperating country. These activities can be terminated at any time at the will of our hosts. Our assistance consists simply of offering an opportunity for observation and study to permit *adaptation* and *adoption* of techniques and concepts from the US and other countries, *if* they are determined to be valid for the country in

* Till recently, Minister-Director, US Technical Cooperation Mission, New Delhi.

question by its own representatives. We certainly do not maintain that the American conditions for high productivity necessarily are immediately applicable in the tremendous variety of different circumstances which prevail in the 62 countries around the world currently receiving American technical cooperation assistance. We do feel, however, that people are basically the same the world over and will and can respond to new techniques offered intelligently.

Further, many of the techniques emphasized in productivity programmes do not conflict in any way with differing cultural, social or organizational patterns, but basically concern only physical phenomena which presumably are identical all over the world. There is no reason why the analytical techniques and control methods of Time Study, Motion Analysis, Materials Handling, Plant Lay-out, Quality Control, Production Planning and Control etc., cannot operate under any given conditions, although the methods of their *introduction* may need to be developed individually for each new set of cultural patterns. Further, many of the techniques are perfectly valid under varying conditions in so far as their underlying theory and assumptions are concerned. For example, scientific attempts to adapt the design of the individual work station to the requirements of the human organism cannot be transferred from western countries to other areas where the worker is accustomed to squatting rather than sitting. However, the underlying idea that systematic thought needs to be applied to the design of the work place to permit the individual worker to most effectively utilize his time and energy cannot be challenged, regardless of the cultural surroundings. In organizing our assistance to other countries' productivity improvement efforts, we permit them to choose for themselves what they will investigate and which activities will be undertaken. We do not require attention to those aspects of the productivity environment abroad which may be peculiarly American or western and which may not be susceptible of transfer to other countries.

This brings me to the doubts we once had on *our* side as to the validity of efforts to "export" our productivity concepts. Since the United States began to assist other countries in industrial efficiency improvement programmes, there has been some worry in our country about the ultimate efficacy of such programmes. This concern is based upon a conviction that the level of industrial efficiency in the United States depends upon the inter-action of the whole range of physical and human factors prevailing in our country. There can be no question that this conviction is a correct one. Certainly the practice of the industrial arts in our country reflects the entire make-up of the US society and culture and our history contains many unique factors which have contributed to high productivity. American attitudes towards work, the desire for self improvement, emphasis upon self reliance, and traditions of social mobility have contributed greatly towards our industrial achievement and are the essential background for many of our concepts and practices. These traditions and attitudes perhaps all result from the fortuitous fact that we are not far removed from the young pioneer society which spread across the North American continent not too many decades ago.

There are many such favourable factors in our culture. Our academic institutions have been quick to adapt themselves to the requirements of an industrial society by introducing the study of new techniques into their scholastic programmes, with the same status as the traditional disciplines. Our trade unions basically devote their energies to the improvement of the condition of their members through economic activities at the plant and industry level. We have the all-pervasive pressure of

competition to keep industrial management alert and progressive. While competition as it was conceived in classical economics is rare, it is true, nevertheless, that individual American firms have no alternative but to keep up with their competitors. The managements who are not able to do so are soon replaced under pressure from the stockholders.

I have mentioned just a few of the many environmental conditions which seem to constitute the essential background of American industrial practices. It is only natural, therefore, for some of us to wonder how productivity can be increased significantly where these familiar conditions do not exist and, more particularly, how the specific techniques and practices developed in American industry can be effective under conditions which depart radically from those under which they have been developed. In the early days of American assistance to other countries in this field, there was occasionally a frustrated resignation in face of what seemed to be entirely unsympathetic surroundings and supporting conditions for the introduction of improved practices. There was also a certain reluctance to be identified with efforts to improve productivity when the atmosphere seemed to be unfavourable for the success of such efforts.

These reactions are no longer met with to any important extent among Americans responsible for technical assistance. Doubts of this kind have virtually disappeared before the solid record of success and achievement of such programmes. We have seen the development of a really dynamic and constantly improving industry in the European countries, which seemed to be a distant goal in the opinion of many American observers when Marshall Plan aid started. The efforts of the European countries to improve and modernize their industrial concepts and practices, with United States' encouragement and assistance. have been remarkably successful. The resurgence of European industry while providing increasing living standards to its workers has been one of the striking developments of postwar history. American producers are now beginning to feel very strong competitive pressure from the European countries in domestic as well as foreign markets.

We have seen that not all of the environmental conditions which we know in the United States need to be present to permit gradual introduction of modern industrial techniques and progressive improvement of efficiency. We thus have developed a pragmatic faith in the dynamic elements in industrial situations and in their eventual triumph over the static forces which often seem to be such overwhelming obstacles to improvement. This triumph will not take place overnight. Limited short term and immediate gains are possible however. This has been proved not only in Europe but in other countries, such as Japan, Mexico, Brazil and Chile. The industrial development of India itself offers adequate testimony to the same effect. Many of the industrial concepts and techniques of the western world have been adapted to Indian conditions and successfully applied to Indian problems. The achievements of the ILO assistance to India in productivity and of the Bombay Productivity Centre of the Ministry of Labour, as well as of numerous private firms, and the National Productivity Council itself, are obvious indications that further progress can be achieved.

It is important to remember that it is only at the level of individual firms or organizations that productivity improvements really can be implemented. An organized national efficiency-promotion programme can only provide to industry of the country an *opportunity* to take advantage of better methods and ideas. Such national programmes cannot *assure* the adoption and implementation of concepts and techniques nor

can they *guarantee* increases in productivity. It is up to the individuals in industry, whether they be directors, managers, technicians or workers to awaken to this opportunity and to progress continually in improving the performance of their various functions. During the last eleven years, we in ICA have seen such opportunities effectively employed so frequently that we have no doubt that it is worthwhile to make them available.

A MAN LEARNS

"Sooner or later, a man, if he is wise, discovers that life is a mixture of good days and bad, victory and defeat, give and take. He learns that it doesn't pay to be a too sensitive soul; that he should let some things go over his head like water off a duck's back.

"He learns that he who loses his temper usually loses out. He learns that all men have burnt toast for breakfast now and then, and that he shouldn't take the other fellow's grouch too seriously. He learns that carrying a chip on his shoulder is the easiest way to get into a fight.

"He learns that the quickest way to become unpopular is to carry tales and gossip about others. He learns that buckpassing always turns out to be a boomerang, and that it never pays. He comes to realize that the business could run along perfectly well without him.

"He learns that it doesn't matter so much who gets the credit so long as the business benefits. He learns that everyone is human and that it does not harm to smile and say 'Good Morning' even if it's raining.

"He learns that most of the other fellows are as ambitious as he is, that they have brains as good or better, and that hard work, not cleverness, is the secret of success. He learns to sympathize with the youngster coming into business.

"He learns that bosses are not monsters, trying to get the last ounce of work out of him for the least amount of pay, but that they are usually pretty good fellows who have succeeded through hard work and who want to do the right thing. He learns that folks are not any harder to get along with in one place than another, and the 'getting along' depends about 98 per cent on his own behaviour....."

Wilfred Peterson.....(In The Sphere)

Productivity & Industrial Medicine

H P Dastur*

THAT "Health is Wealth" is nowhere more true than in industry. Health, however, has to be understood in its broadest sense: physical, mental and social. The chief burden of this thesis is to prove that the main cause of the ills from which our industry suffers is not cussedness, either of labour or of management, but the general prevalence of ill-health, acute or incipient. What makes matters worse is labour and management's ignorance of the nature of this ill-health. Worse still, little is done, even when attention is drawn to it. The fact really is that there is no trained staff to deal with this problem, whose solution would make an immediate and substantial contribution to industrial productivity. The failure to solve this growing problem of industrial ill-health is bound to cause tensions, bad industrial relations and lower levels of productivity than would otherwise be possible.

Man is an aggregate of several organs, each with its distinct function; but what affects a part can influence the whole organism. Yet neither management nor labour is interested in the whole man, but only in a fraction, and there too, each selects a different part. Management needs mainly man's muscles and brain, whereas he himself is more interested in his stomach, and still more in his heart. He certainly holds a stake for money, but status carries with him a higher value. Management sometimes willingly, sometimes under pressure, offers enough bread for his stomach, but has poor knowledge of foods that can nourish his heart, and shows little desire to acquire it. But man is so much dependent on his emotions that he is at times willing to starve his his stomach if that can help him in his fight for proper and enough food for living a healthy emotional life. That depends on satisfying his social and psychological needs, besides those necessary for his creature comforts.

Modern industry has social and moral aspects, besides economic and technological. The integration of all these aspects into one whole unit of production is necessary if industry is to prosper. Such integration depends on taking care of man's many and diverse interests and needs. When these needs are starved, fears and suspicions assail him which spoil his health and give a wrong turn to his energy. End-results are either hate and opposition, or frustration and apathy. Because he is rubbed the wrong way, the worker loses heart to work, and prefers strife, though inherently he is a peace-loving animal. Most of us have "childish minds in adult bodies," and if we are to grow mentally, we need to be handled with care and understanding. It is correct to say that there are no delinquent children, only delinquent parents. It is also true that trouble-makers in industry are products of immature leadership.

Strange as it may seem, mental illness, more than physical, is the cause of

* Dr. H P Dastur is a distinguished veteran of the Tata's. He was, for 12 years, their Chief Industrial Health Officer. He is at present working as a private consultant whose advice is much valued, particularly in Bombay industrial circles. He has embodied his lifetime experience in a volume (shortly to be published): *A Doctor's Approach to Industrial Medicine.*

industrial ill-health and loss of production. Mental troubles can lead to physical troubles (and very often to accidents) and are the chief factor in unsatisfactory relations between employer and employee. Whenever a serious industrial dispute is on, the management's representatives are loud in asserting that the whole trouble is engineered by a few malcontents, and workers are equally emphatic that the root cause is a small percentage of officers. An analysis of medical examinations of 1568 operatives in the Department of Industrial Health with which the author was connected revealed that nearly 18 per cent of the examinees were maladjusted on work, that is, their working capacity did not match the physical demands of their jobs. A study of sickness absenteeism during 1952 of 5,800 operatives of a factory revealed that about 25% of the personnel studied accounted for 75% of sickness absenteeism. According to Dr. Fraser's research, nearly 30% of working personnel suffers from industrial neurosis, and Dr. Fulton's research makes out that majority of human relations problems arise in this same 30% group of Dr. Fraser. Each one of the above factors is either the cause or effect of outraged feelings. What is necessary is to substitute for mental and bodily illness the joy and vigour of healthy minds in healthy bodies. To be able to do so, however, one has first to probe into the thoughts, feelings and behaviour of people at work.

Just as the birth of industry is the result of man's creative energy, its maintenance also depends on that same energy, but this is conspicuous by its absence from a large section of industrial management. In underdeveloped countries, one reason for this may be malnutrition of its masses. In the author's Department, medical examinations of 13,765 industrial employees showed that 35.3% were underweight even according to Indian standards, and 16.9% showed signs and symptoms of specific nutritional diseases. Through no fault of their own, the best effort of such employees may not make the lowest standard of economic productivity.

All employees however are not suffering from malnutrition, nor is malnutrition the only cause of low productivity. Even when the capacity for work is there, the will may be lacking. So management is much concerned that the general run of its operatives is working because they have to and not because they want to, and is much embarassed that it has no clear vision how to convert an unwilling into a willing worker. As mass production techniques are developing, most operatives find that these techniques demand less and less of their creative energy, and serve less and less their vital needs—the one incentive that can motivate them to hard work. Without this incentive, work fetches them little pleasure and many frustrations. They do as little as possible, and sometimes even that little in a perfunctory way. All this is happening just at a time when increased production is the crying need of the hour. This compels industry to look around in every possible direction to discover ways and means that can increase productivity.

Social scientists like Alexander Leighton and Stuart Chase have made careful study of culture concepts of various societies through systematic observations with many checks. The weight of their evidence favours the view that *man is a working animal.* To remain happy and contented he needs work that can use his mental capacity adequately; work that can make life worth living in face of hardships, where frustrations appear as challenges for further determined effort; work that enables him to see and find his place in the scheme of the universe of his imagination; work which can enable him to grow, for life is continuous growth

like that of a seed striving to burst into light out of darkness. It is only such growth that can lead man to realise life at all levels—physical, mental, moral and aesthetic, that is, to attain positive health. It is the proud privilege of the employer to lead his employees to this high estate, and help himself in doing so.

Much of what appears irrational in the behaviour of an industrial worker or a group of such workers, is in defence of his primary social needs. When he is pushed about as a means to another's ends, when his physical environment is likely to affect his body health, or when his social *milieu* seeks to trample upon his social needs of recognition, self-importance and self-expression, work bores him, tires him and sometimes so exasperates him that to destroy rather than create becomes a passion, in the hope that thus he may gain back his human dignity. All this adds up to a rising rate of mental illness, and the lone voice of the science of man cries out in vain that the only remedy is work, and still more work, but work in the service of humanity. So the bewildering fact remains that the industrial worker often works less than what he can and ought to, and worse still, does not realise that this way he may be inviting his own ruin also.

But what has medicine to do with all this? Has an industrial physician like the author any *locus standi* to address management in this vein? Perhaps yes. Recently a WHO|ILO Conference on industrial and occupational health in the South-East Asian region was held in Calcutta from 24th November to 5th December 1958. One of its draft conclusions has been that, among other things, management and supervisors should be given some orientation towards occupational health.

The industrial structure rests on three pillars: materials, methods and men. While industrial organisation has even from the very beginning of industrial revolution paid systematic and increasing attention to materials and methods, the very idea of at least equal attention to men is recent. It began in American industry with the realization that non-attention to the human factor was a serious drag on productivity and that such attention paid dividends to employers, both in financial and non-finantial terms. In undeveloped economies, the realization has hardly dawned that not only are certain materials dangerous to men, but that certain methods just break down men.

If materials and methods are adjusted to men, rather than the other way about, we shall realise the full potential of man's productivity, which is obviously much higher than his current rate of output. Productivity is often measured by man-hour or machine-hour, but man-hour does not go by the clock but by man's health, especially by the state of his emotional being. It is a commonly known fact that a man, if he so chooses, can put a lot more than sixty minutes in an hour, or a lot less! It need not be emphasized that as the potential of man-hour depends on employee health, its care must become a vital function of business management.

Man does not function in a vacuum but in a biological stratum of evolving growth regulated by human needs and values. Management has to make up its mind to understand and respect these values, if its interest in productivity is to be fruitful. A serious beginning in medical arrangements for industry would convince the working class that the management has a realisation of human values by which they live. In fact, without an organised system of industrial medicine, industry will continue to be a tussle between machine-hour and man-hour, lowering the potential of both. With its help, machine-hour and man-hour can be harmonised at the optimum level of productivity.

Industrial Medicine sprang into prominence during World War II, as a method of conserving manpower so badly needed to increase production, and medicine was then faced, for the first time, with wide social and economic obligations. To discharge them faithfully during the post-war period of reconstruction, medicine has realised that it must fit itself into the background of the social and economic picture, as it exists, with its many problems of mass welfare. So far, medicine has been mainly concerned with the prevention and cure of disease in individuals, but, after the experience of World War II, it is becoming increasingly conscious of the constructive and the much more useful part it has to play in providing medical aid to masses for their all-round development. Organised medicine is now convinced that problems like those of tuberculosis, venereal and occupational diseases, including industrial neuroses and malnutrition, are really medico-social problems, and that their solution depends on an integrated concept of medicine. The basic principle of this new constructive trend of medicine is to strengthen the inner adaptive forces of man to meet the challenge of a strange and inimical physical and social environment. And as an aftermath of the two world wars, man's environment is growing stranger and more difficult, especially in industry. His adaptive forces however depend as much on laws of physical, chemical and social sciences as on any biological laws uncovered by medicine. Therefore, the modern trend in medicine seeks to join hands with all other sciences that can help in evolving a scheme which can set man going on the road to positive health. This is what Industrial Medicine practises on industrial workers—a truly social function. This raises the status of the industrial worker from that of a mechanical component of the machinery of industry to that of a human member of society.

Without question, industry needs medicine, and the need is daily growing because the industrial structure is ever growing more complex. It is however not a purely humanitarian obligation, but an organisational necessity for the growth of industry, nay, for its very existence.

Beginning with the Crimean war, in which many more British soldiers died of sheer sickness than from enemy action, governments have realized by painful experience that sickness among soldiers is a major cause of losing battles. Army morale has greatly increased since the entry of Florence Nightingale and her philosophy into the army system. Equal material benefits can be realized from adequate hospital facilities for the industrial worker.

These ideas have yet to find acceptance among the Indian people. Quite a lot of effort will have to go into, in the first instance, raising the mass of workers from a negative to a positive state of health, with the worker properly nourished, using his working capacity to the utmost and drawing real satisfaction from his work; for nothing is more fundamental than the fact that the worker's health is his real wage. From the employer's point of view, it is an undisputed fact that healthy people do better work, that is, produce more goods at less cost, which is the essence of productivity. Industrial medicine, therefore, is a first class investment and a desirable tool of production. Industrial medicine is in fact an efficient and advanced tool for achieving a massive increase in productivity. It can produce what would be for the country the most valuable asset—mass production of healthy individuals. The best contribution, therefore, that can be made to productivity in this country is to impregnate factory managerial policy with the concept of positive health. This calls for an industrial health service within the factory. Without it, industry would be a tussle between machine-

hour and man-hour, thus lowering the potential of both; with its help it can increase productivity by welding the two together into a harmonious and therefore a productive unit.

It has often been said that if the community is to prosper, man must adjust himself to the demands of industrial environment, but there is a limit beyond which man cannot adapt himself to hostile conditions or an uncongenial social situation. There is a contradiction between industrial technology and humanism, which can only be harmonised through an industrial health programme. Man, of course, has an inherent adaptive capacity for resistance to disease but this adaptive capacity has to be strengthened by an organisation, developed for the purpose. Such an industrial health programme has to be mainly preventive and constructive in nature, and has to stand guard over the whole person of the worker as a human being, head of a family and member of society. It has to be a multi-pronged service, consisting of medical aid, environmental and mental hygiene, research and welfare work.

The main objective of industrial medicine is to match work and worker. If a man is put on a job which is above or below his capacity, it causes aggression or frustration and an aftermath of neurosis and psychomatic diseases. A well-organised system of industrial medicine assesses the worker's physical and mental apparatus and with the help of other technicians on the line makes a broad judgment of the way in which he would be most productive. Such an examination is known as placement medical examination and it can yield good results in terms of industrial productivity. But to maintain the good start, periodical medical examinations are necessary, as also attention to public health aspects of nutrition, immunization, sanitation and industrial wastes.

History of the industrial revolution is characterised by increasing numbers of immature people manning most key-posts of almost all activities of man. The result of this on individual workers has been a fruitful crop of industrial neuroses, portean in nature, difficult to diagnose and handle, and disastrous in their cumulative effect.

To find an antidote for this social poison, the industrial physician has to join hands with the social scientist, and create conditions for positive health. The test of positive health is the extent to which it creates job satisfaction. Aggressiveness is a hallmark of all life and the main source of all energy—good or ill. What can lead to a real sense of job satisfaction is work that can absorb the individual's specific aggressions into a productive instead of a destructive channel. Further there will always remain a residue of grievances which can only be dealt with by the industrial physician. Also the worker may prefer to open out his mind to the physician rather than to his administrative supervisor.

It is however not possible to lead a person towards positive health without studying his environment in order to undertake preventive planning for removal and control of health hazards. These may arise from risks of accidents or their nature may be physical, chemical or biological. The right time to tackle them is at the blueprint stage of a new factory, a new machinery, a new manufacturing process or a change in the old one. Hazards arising out of improper illumination, defective ventilation with special reference to exhaust systems, wrong designs which lead to difficulties of good housekeeping and exemplary cleanliness, faulty installation of machines involving operatives into adopting unhealthy postures for running machines, creep in when the health service is not consulted at the very beginning. It is cheaper and more effective to prevent such hazards at the start rather than to undertake to remove or control them through engineering re-

vision after they are allowed to appear in the production line.

Such early consultation should be routine policy but that is seldom so. Therefore, the next move has to be an industrial hygiene survey of every workroom to determine health hazards lurking in the environment and design of the room. Handling of or contact with solid, liquid or gaseous raw material used for feeding or cleaning machines, bye-products arising out of the manufacturing process, and sometimes even finished products may be a source of one or other type of health hazard. Industrial hygiene survey has to cover every such article.

With regard to the mental hygiene programme, it is necessary to say here that *the mind carries a much higher potential to heal or harm the body.* Another reason why this programme carries special importance is that it is necessary to clear the ground for acceptance of the rest of the activities of the service. Yet another is that the social format can affect mental health, and in industry this format is growing more complex and more dangerous. The objective of this activity is to strengthen man's inner adaptive forces to withstand undue fears, suspicions, frustrations and misunderstandings which can harm his health, and when perchance the latter get the better of him, to help him with mental first aid. This is nothing more than having open ears, but they must be combined with open hearts and open minds. Mental first aid is just a matter of listening, but with sympathy and with readiness to admit when one himself may be wrong.

Coming to welfare activities, they are necessary to fill in gaps in the physiologic and social needs of employees, left by the above activities. These relate to nutrition, recreation, education and economic needs. But the worker can appreciate welfare services only as an adjunct of the above type of service. Industry needs the higher ideal of tapping the reserve energy of the employees through a human approach which can counteract the cramping effects of the mechanical approach of mass production. The human factor is gaining increasing importance in industry. It is now an anachronism to divide groups into productive and non-productive departments of a factory. Output depends on the integration of functional services of industrial health with the technical services of the production line. Modern industry has to justify itself through its contribution to mass welfare, which however is not amenities but the right atmosphere where the worker can breathe the air of growth and development and think constructively so as to understand the play and interplay of his subconscious instincts and conscious emotions.

A social revolution is in process, leading to a changing emphasis on the ultimate goal of industry. The profit motive is linked with social responsibilities in the felfare state which lays increasing stress on the development of people. Industry's need of the hour is men of vigour and character, and an industrial health service of the above type seeks to build such men. It is welfare work *par excellence.* The wonder is that so many show concern about productivity, and so few use this service that can increase it.

It is not rare to come across a modern streamlined factory with plethora of creature comforts, but its production compares unfavourably with that of an old dilapidated structure where however human values find scope, though its working conditions leave much to be desired. This difference in the psychological climate of different factories according to Maclean and Taylor may be traced to what they term "the personality of the organisation." To quote them: "each industrial organisation represents a unique whole.... This organisational personality represents the major purpose, policies, practi-

ces, affiliations and values which define and symbolize the identity of the company.... This characteristic personality of each organisation presents a strong social pressure for each employee." For this reason an industrial health service has to accept the factory itself as one more client.

The operative forms the bulk of the *clientele.* His health concerns every aspect of industry. But health is not a ready-made packet that can be bought or sold in the open market. Mental health is often a matter of preventing misunderstandings. This has to be a laborious process of collecting all facts of a health problem and weighing them before taking any action. For instance, a worker may have stomach ache, but it may be due to the mental strain of a job much below or above his capacity. Basically ill-health may be due to ignorance of laws of health, but enforcing medical edicts through law and disciplinary action is not the remedy. One has to encourage thinking that can change wrong health habits through inner conviction.

To cite an example from the author's experience, snacks used in a factory canteen lacked nutritive value. It was decided to substitute them with others, containing protective foods. Group discussions were held with the representatives of workers to explain to them the need for the change, and the same was effected with their consent and participation.

What stands repeating is that the operative's own good and that of his employer, and in fact of every aspect of modern industry, depends on his working capacity. To safeguard it he needs the service. It seeks to uphold his human dignity and this helps him to maintain allround health. It leads him to progress, towards a higher living standard, and offers him better opportunities to realise life through work. Modern industry is sick with a serious malady. Production is lower than its normal capacity. Employees sometime resort to go-slow tactics; employers show poor response to new ideas; and governments overtreat the malady with an inordinate amount of labour legislation. Recent labour laws confer numerous benefits on the employee. But they do not directly raise his output of work, because technology is increasing occupational hazards which affect both body and mind, and enough is not done to control such hazards. The operative needs health, not legislation—especially mental health—in shape of understanding the tremendous importance of his contribution to the national good. Such an understanding depends on industrial physiology and psychology, and not only on wage incentives or amenities. Industrial physiology covers body responses to work and assesses the physiologic capacity of persons to work and the physiologic requirements of various kinds of jobs. Industrial psychology makes similar assessment of mental responses in relation to work and the psychologic effects of work on the emotions of persons. But to do all this, industrial health personnel have first to tackle the staff of line management, to lead them out of preconceived and out of date concepts of business management, and towards realities facing them today.

The supervisor or the executive is in a way also an operative when he is working under somebody. So all that applies to the operative applies to these two also. In addition the service can help them to supervise better and with less headache. But they have serious doubts that output depends more on their own health plus that of their operatives than on the technical skills of management The fault is not theirs but of their training, especially of a decade or so ago, which stressed that production needs more attention to the direction of things than to the development of people. So their first impulse is to reject the advances of the service or to tolerate it as a nuisance if it is forced

on them. Sometimes they also suspect that the service may curtail their authority, and so offer it active opposition. Such indifference or opposition is not born of cussedness, but arises out of incomplete knowledge of the service, which happens when the latter fails to speak to them in their language and explain to them that all it seeks is to place before them facts of human needs and behaviour so that they can take timely action to advance production and not to usurp their legitimate function of making decisions.

Regarding the executive, he has to pass down the policies of the higher-ups and see that they are fulfilled. The service can create and maintain for him a psychologic climate that can ensure willing acceptance and smooth running of the policies. Ill-health is contagious, and a supervisor or an executive going through it can pass it on to his group. And as prevention is the mainstand of the service, the health of these two categories is one of its chief responsibilities.

A few decades ago, the supervisor was all in all, who assumed that power is knowledge. The fact really is the other way about: Knowledge is power. Slowly but surely, supervision is becoming an art to be learnt through patient, continuous and special training for handling people at work, and the industrial health service offers to the supervisor a technique to develop himself into the higher status than ever before of a leader and morale builder.

Like a good teacher, an efficient supervisor must be prepared to go on learning. This is only possible if he has grasped the main principles of positive health—his own as much as that of his group.

Arguing in the same vein, policy-makers are in a position to create a pandemic of ill-health throughout a factory. They would be well-advised to use the service to avoid such a disaster. It can guide them where a particular policy of theirs is likely to affect adversely the health and emotions of their employees and how that can be avoided, and that without jeopardising the main core of the policy.

It is however the factory itself that needs this service most and can benefit most from it. Without it a factory is likely to show the soulless aspects of a prison. Prisoners are recognised as numbers and have to respond, like marionettes, to the jailor's rod. Similarly, employees become hands who, as cogs in a wheel, must move as directed under the threat of punitive measures. With it, a factory may turn into a home where management and labour may live a happy family life of mutual trust and joint effort for the common good of both.

The type of health service, suggested above is, it must be confessed, somewhat idealistic, for the special trained staff that would be required for such a service would be hard to find in India. But a beginning can and should be made, if a massive dent has to be made in the obstructions in the way of the productivity drive.

The question then is how the service is to be organised and what are to be its proper functions. It is obvious that the service can only function in an advisory capacity. Its proper function is to collect all health data of individual employees and also of the factory, discover sources and trends of ill-health, and suggest ways and means for control of all hazards likely to lead to ill-health, but the actual implementation of the ways and means has to be the responsibility of line management which however it often does not accept.

Who is ultimately responsible for the health and safety of the industrial employee, line management or the functional staff? When the author poses this question before representatives of line management on the shopfloor or in training courses of business management, they reply by asking the author

the following questions :—

1. We are engineers or administrators and not doctors. Then how can we have a role to play in maintaining the health of workers?
2. Our main concern is production. We accept that a healthy worker is likely to do better than an unhealthy one, but can our interest in his health increase his output?
3. If such a role is considered necessary or desirable, what should it be, and can we find time for it?

The author's reply takes the following lines : Health is infectious. You can pass your good health or ill-health to your group. Your ill-health can freeze the working capacity of your group and your output may suffer. The service can make you aware of your ill-health. This applies to your operatives also but they learn by example and not by precept and the only example they face, day in and day out, is you. The cause of your operative's ill-health may be outside you. But you are his leader and you are with him for 8 hours a day. In the circumstances, you should be able to detect early symptoms of ill-health. As his boss and friend it would be advantageous from all points of view to give him first aid. It is bound to pay dividends in terms of output and increased productivity. You may not be knowing the right type of first aid but the service is there to train you and you should welcome such training. Further the service can help in clean housekeeping and accident prevention. Poor housekeeping and accidents reduce output, cause waste, both of men and materials and increase cost. It is a tragedy that often it is difficult to pursuade management that housekeeping, accident prevention and first aid are part of supervisory responsibility. It is easy to plan health and safety but difficult to integrate it into the production machine, and the difficulty increases when policy-makers do not consider the industrial health service as a productive department, and do not lay it down as a '*must*' of their policy and see to it that it functions.

Industrial management shows a general tendency to divide its departments into productive and non-productive according as they are connected with the manufacturing process, that is, with methods and materials, or with functional services like those of medical, personnel, public relations departments and so on, which relate to men. Officers manning the former are labelled as technicians, and the latter as non-technicians. This is a fallacy and a lingering legacy of the materialistic philosophy with which the industrial revolution began. Officers of functional services are as much technicians as any other.

In the early days of the industrial revolution it was perhaps commonsense for industrial management to adopt a policy of hiring, bossing and firing, because it was the belief of industrialists of that period that the progress of humanity depended on material prosperity. What the worker felt about his work or his employer was considered irrelevant before the greater good of the whole community. This was soon found wanting, for, like water the spirit of man is irrepressible. One can suppress it and oppress it upto a limit beyond which it gathers increasing momentum until it bursts into revolt.

As the materialistic outlook on life still held strong sway, commonsense dictated that management give labour a larger share of the material cake. This brought in paternalism and industrial liberalism of subsidised canteens, medical aid, uniforms and such other material benefits. As already stated, evidence is available that some factories with a plethora of material amenities compare unfavourably regarding indus-

trial relations between management and labour with some others without such amenities. Something more vitally needed which was available in the latter was not available in the former. The Hawthorne experiments and similar other researches have proved that materialistic benevolence however well-meant is a negligible factor in job satisfaction, and cannot lead to willing cooperation.

The collective aim of all the activities of the industrial health programme is to take care of the sentiments of workers and canalise them into channels of spontaneous cooperation. Increased production is the need of the hour, but output, morale and goodwill run in a direct ratio. Technical progress is necessary to increase output and it certainly can, but only if side by side, human values are given a central place. When that is not so, technical progress can act in the reverse. Its methods of rationalization and simplification of jobs have a tendency to iron out the worker's individuality which takes away from him his natural incentive to work hard. Modern industry has a social responsibility of developing the worker's individuality. To fulfil this obligation the employer needs to instal an industrial health service and give it the same importance and attention that he gives to his purchase, production, sales or finance department.

When the industrial revolution first started, the employer would not or could not accept the fact that labour can have a point of view. He expected the worker to do as ordered and take his wages for it. In time, due to this policy, the going began to grow hard, for workers began to organise and become conscious of their rights. So the concept of management had to change. The thinking employer realised, while the unthinking one was made to do so through compensation laws, that the care of the worker's limbs was a matter of importance to him. When he did that, he discovered that this depended a great deal on the worker's state of nourishment. He started canteens and even subsidised them. From this to industrial enviromental hygiene is a logical step. There is no sense in providing a worker with a well-balanced diet if at the same time he is allowed to swallow poisons and dust, and breathe air contaminated by dangerous fumes. Half measures are no economy in the long run.

The rapid progress of technology does not give the employer enough scope to realise in time the full significance of physiologic and psychologic effects on the employee of such advance if left unchecked. It is not so difficult for the employer to accept the need of the personal and environmental hygiene part of the programme, if the economic side is properly explained to him. Finding good results through environmental hygiene he is generally ready to use the worker's brain also through suggestion box schemes and through joint consultative committees. But the worker has a heart too, and even when the employer realises that privileges must be the result of well-performed duties, he finds it difficult to understand that the worker's feelings affect all that happens from either end—the worker's or the employer's. Respect for the worker's heart is a hurdle which the employer has to negotiate for his very survival. The worker's feelings can make or mar the employer's best laid plans and best intentions. The difficulty is that human nature is an abstruse combination of the conscious and the unconscious mind, of reason and instincts. And when the two pull against each other, as they very often do, they give birth to industrial neuroses and psycho-somatic diseases. These are difficult to diagnose, to analyse or to treat. The industrial health service however can help the employer to bring his headaches within tolerable limits. But at what cost, he asks.

Generally speaking, the employer belongs to the tribe of financiers whose main interest centres round the profit motive of quick returns on the invested capital. But the benefits of health programme are mainly intangibles like increased efficiency, improved employment relations, reduction in absenteeism and turnover and so on. It is difficult to convert these into a profit and loss account. But there are tangible benefits also like reduction of accidents leading to lowered direct costs of compensation and treatment and indirect costs of damaged equipment and lowered production. Moreover, money makes money is no more true. Men make money. Ours is an industrial culture based on money economy which even today is the guiding principle of the majority of employers, but it has led us into a sorry state of affairs. Because of that a new era of health economy is springing up, which has a promising future.

The employer who asks whether in the present state of increased competition and pressing need to reduce production charges, and high living costs and increased taxation, industry can afford to run an expensive health service with its array of costly officers and equipment, needs heart-searching whether lowered profits may not be the result of a narrow and wrong materialistic outlook. The question before the employer is not whether industry can afford an industrial health programme, but *whether any industry, small or big, can afford not to have one.* The answer is no. The employer has first to fulfil his social obligations before he can reap any economic benefit for himself. For this, industry and medicine have to join hands. But the amazing thing is that few industrialists, especially in under-developed countries like India, hold at premium their employees' needs of health through fulfilment of human values. Productivity is an expression of these values at work. To look for it outside them is to run after a mirage.

★

HOW TO BE AN UNSUCCESSFUL EXECUTIVE

1. Always be possessive—"I" every action, "My" every employee. It gives everyone a feeling of personal worth.
2. Consistently violate, personally, all the established rules. Prove conclusively that such trivia are not for you.
3. Give ambiquous instructions. Then if an employee errs, you can always blame it on his simple-mindedness.
4. Throw out as many sarcastic rejoinders as possible. It is evidence of your mental alertness.
5. Never express an opinion if you can avoid it. Someone might quote you.
6. Never praise good work. The employees might request a raise.
7. Don't ever be receptive to employee's ideas. Who is running this business anyway?
8. Never make it quite clear who is responsible to whom. You will have a more "elastic" organisation.
9. Be cold to all complaints. If they don't like the way you treat them, they can always work for someone else, can't they?
10. Don't encourage employee's educational endeavours, either within the organisation or without. Someone might steal your job.

And don't smile, friend, until you do some personal interrogation!

Experiments in Productivity

A major aluminium manufacturer in India has, in the recent past, achieved noteworthy increases in productivity, which the National Productivity Council considers worth reporting. The technical improvements have been brought about, not through inspiration or sudden hunch, but by analytical survey and hard work, done by the Company's Methods Study Department. From time to time, the Department has undertaken projects for effecting increases in productivity through improved (cost-reducing) methods. These projects have resulted in considerable savings in fabrication costs. A few of the successful projects have been detailed below; and it is the conviction of the National Productivity Council that analogous productivity increases can be achieved by all manufacturers through the setting up and efficient working of a Methods Study Department. The following account proves what can happen when such Departments are set up to seek out better methods.

1. POWER CONSUMPTION CONTROL

The electrical power cost constitutes approximately 8% of the total fabrication cost and more than 25% of the total labour cost. Thus power consumption forms an important single controllable item in the total fabrication cost.

PREVIOUS METHOD

In the past there was no systematic control of power consumption. As a result considerable amount was lost due to waste, power factor surcharge etc.

PRESENT METHOD

The scheme introduced for control of power consumption has the following main elements:

(1) Operation of all equipment at peak rated capacity and shutting down when required output is reached so that all idle running is eliminated.

(2) Simplification of machine operation wherever possible for decreasing energy consumption with same output.

(3) Maximum demand control for getting higher load factor and lower unit cost.

(4) Power factor control to keep it above 0.95, thus eliminating power factor surcharge.

BENEFITS

The result of the control has been satisfactory and the unit consumption per ton of output has come down from over 2000 to less than 1400, a good portion of which is attributable to this control scheme.

II. COST CONTROL

(a) CHEAPER SUBSTITUTE FOR SELLO TAPE

Materials packed in wooden cases are given a paper and alkathene coated paper lining in the form of an envelop. These envelops require to be sealed.

PREVIOUS METHOD

Sello tape, an imported commodity, was used for sealing envelops. Since the material was getting scarce and very costly it was felt necessary to find out a suitable substitute.

PRESENT METHOD

Various types of gummed tape of indigenous make were put into trial. The main points of consideration were the quality, the method of application including implements needed for the purpose. The application of one of the indigenous make gummed tape with an efficient dispenser proved successful and was finally introduced and the process standardized.

BENEFITS

This has resulted in a saving of Rs. 4,000/- per month.

(b) REDUCTION OF PLANK PROCESS SCRAP

The project was opened to consider the possibilities of minimising scrap loss in the manufacture of packing cases of different sizes and effecting price economy by utilisation of short length planks.

PREVIOUS METHOD

In this method, planks were purchased in 6′ to 8′ lengths. Each piece was measured after inspection for making payment and stacked in one heap. During the manufacture of packing cases, planks of any length were issued from the heap. This resulted in high process scrap.

PRESENT METHOD

In this method, the planks are purchased in 3′ to 6½′ lengths. They are then sorted in lengths of 6″ group interval. Simple gadgets provided for sorting out planks of different lengths has quickened the process of sorting. Mean lengths of each group are taken for measurement and making payment. They are then stacked separately and issued as per requirement. Services of two extra men are provided in this method.

BENEFITS

(1) About 10% decrease in process scrap.

(2) About 10% decrease in price of planks due to shorter length.

(c) RECLAIMING COTTON GLOVES

During processing of aluminium products the operatives are required to put on cotton gloves. Expenditure on gloves was around Rs. 2,000/- per month. A project was taken in hand to reduce the cost.

ORIGINAL METHOD

Used gloves were generally thrown away and replaced by new ones at the beginning of a new shift. It was observed that 50% of these used gloves were good but could not be utilised due to too much oil and dirt.

IMPROVED METHOD

It was felt that if 50% of good quality gloves could be reclaimed, the cost on gloves could be brought down. Different washerman and steam laundries were tried without success. On their failure to give us a cheap and satisfactory wash, a project to find out an improved method of washing was taken in hand. After a long and elaborate trial a process was evolved to wash the gloves perfectly and economically. The cost of washing was found to be around Rs. 8.75 against the purchase cost of Rs. 34 per 100 pairs.

To facilitate heating of soiled gloves with detergent and to churn while heating, a mechanical device has also been evolved.

BENEFITS

Savings in purchase cost of around Rs. 600/- per month.

III. PROCESS ANALYSIS

(a) PROCESSING OF CIRCLE PRODUCTS

Some facts on processing equipments :

(1) Hot rolling : Minimum hot rolling width with available casting is 20".

(2) Strip roughing: Any width up to 36"

(3) Strip finishing: Any width up to 26"

ORIGINAL METHOD

To manufacture, say 16" circle products, the process had been as follows :

(1) Hot rolled to 20"

(2) Strip roughing: 20" wide coil

(3) Strip finishing: 20" wide coils in strip finishing mill.

Result : Loss of 4" wide strip along the whole length of coil.

IMPROVED METHOD

(1) Hot rolling : 33½" wide

(2) Strip roughing: 33½" wide coils

(3) Slit two 16¾" wide coils

(4) Strip finish each of two 16¾" wide coils in strip finishing mill.

BENEFITS.

Scrap of 4" strip along the length of the coil reduced, thus improving on recovery by about 7.5%.

(b) WORK STUDY IN SCALPING LATHE

Top and bottom surfaces of ingots of sizes 26½" x 6½" x 31" and 19½" x 5½" x 31" weighing 500 lbs. and 300 lbs. respectively are scalped to remove surface defects.

ORIGINAL METHOD

In this method, the tool traverse speed utilised was 4" per minute, and the feed used generally was in the range of 1 16" to 1 8" requiring 2 to 3 cuts per face. Since the machining time was around 70% of the total cycle time, improvement on machine time was felt necessary. .

IMPROVED METHOD

In this method, tool traverse speed was increased from 4" per minute to 8" per minute by changing the pulley diameter, thus bringing down the machine time by about 50%. Again, the feed was increased to 3 16" and number of cuts required per face standardised at 1 to 2 cuts

BENEFITS

The benefit obtained from the introduction of improved method is shown below :—

Ingot Weight	Original Standard Output	New Standard Output after Methods Improvement	Increase
Lb.	Pcs/Shift	Pcs/Shift	%
500	10	17	70
300	18	22	22

(c) WORK STUDY ON 1st COLD ROUGHING OF FLAT SHEETS AT FLAT ROLLING MILLS

To get increased plant output with the existing equipment and machines, it was found that the flat mills would create some bottleneck. A project was taken in hand to ease out the bottleneck by improved methods.

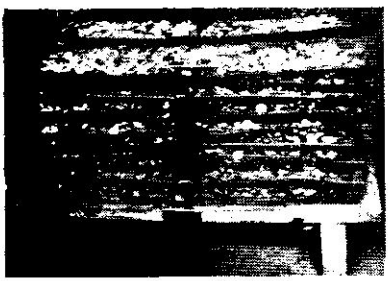
ORIGINAL METHOD

In this method, sheets of various sizes and gauges used to be manufactured from single length slabs, that is, slabs were chopped into pieces required and each piece would make only one final sheet.

(1) Original Positioning of slugs

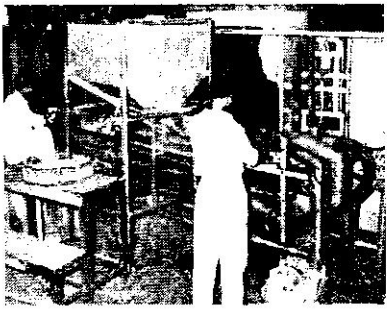
(2)

(3)

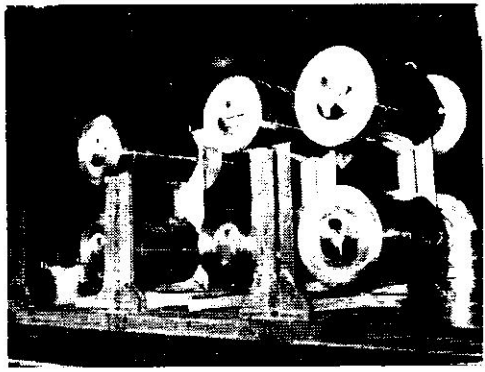


(4) Rectangular shallow trays

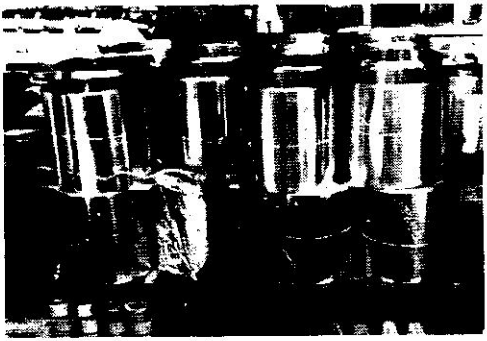
(5) Introducing trays, steel chairs etc.



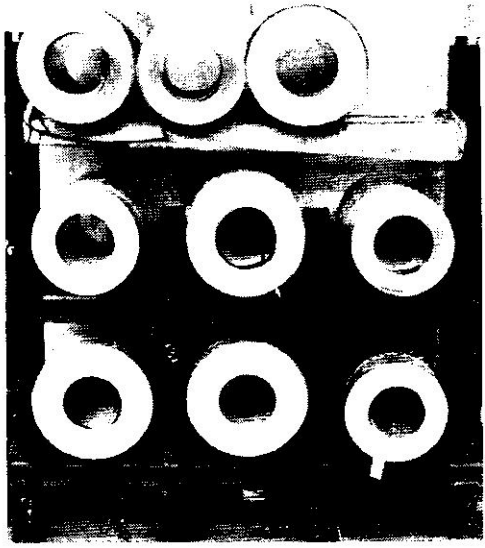
(7) Improved inspection by conveyor-type machine



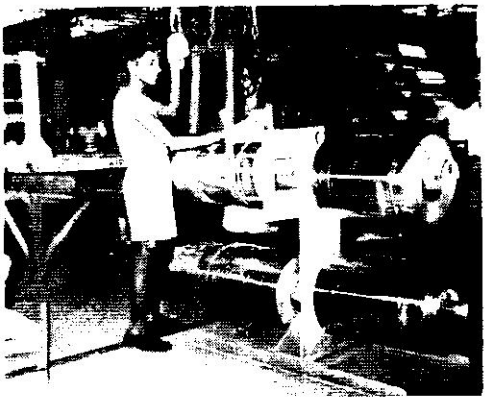
(10) Trees on annealing racks



(8) Original coil annealing on racks



(11) Improved Method of Stacking Coils on pallets.



(9) Improved coil annealing horizontally on trees

IMPROVED METHOD

It has been found that the increase in length of sheet during cold rolling does not increase the work content proportionately. The sheets are therefore rolled in double length during 1st roughing. As the sheets become too long in later stages of cold rolling, they are sheared in two halves and finished in single length.

BENEFITS

Productivity in Ist roughing operation increased by 30%.

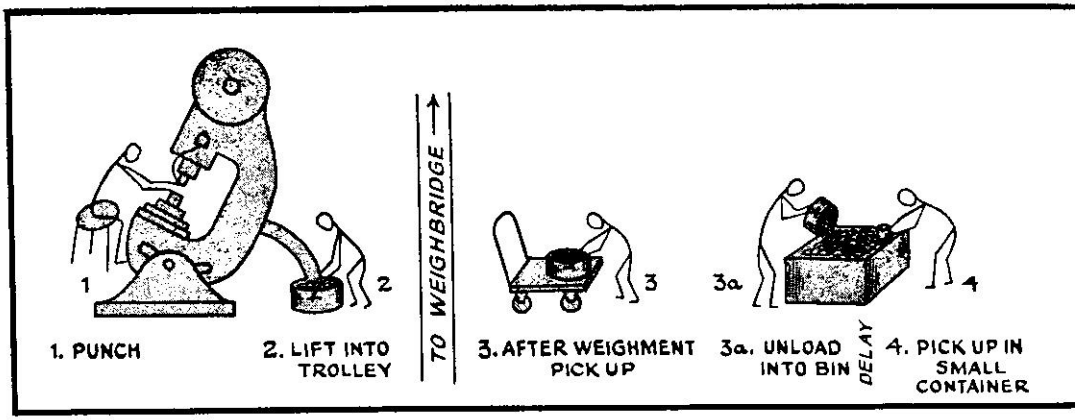
(d) WORK STUDY AT DIFFERENT STAGES OF PRODUCING SLUG

Fabrication cost of producing aluminium slug was found to be high. A project was therefore taken in hand to find out improved methods at different stages of the production line with a view to processing them economically.

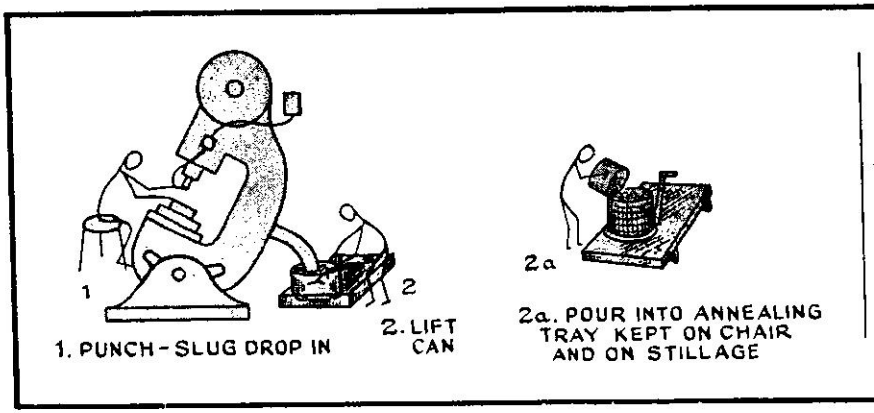
Original and improved methods and the effect of improved methods on productivity are shown below :

	DESCRIPTION	*Original Method*	*Improved Method*	*Effect on Productivity*	*Improvement*
1.	Stoppage of presses for feeding strips	Strip length 30"	Strip length 45"	Press idle time reduced	20% increase in productivity
2.	Stoppage of presses for filling up glass lubricator	Intermittent type	Continuous type	Press idle time eliminated	
3.	Increase press speed	85 r.p.m.	105 r.p.m.	Increased output	
4.	Cold rolling time	Narrow sheet of 30" width	Wider sheet of 45" width	Increased output	
5.	Shearing strips	30" strips	45" strips	Shearing time reduced	30% increase in productivity
6.	Washing of slugs	Washing with kerosene oil	Use of non-staining lubricant	Washing eliminated	
7.	Slug trays for annealing	Rectangular shallow trays (Photograph 4)	Deep circular trays	Positioning of slugs eliminated (Photographs 1, 2 and 3)	
8.	Annealing	Bottleneck observed in annealing furnace	Introducing trays, steel chairs for annealing slugs in a preheating furnace which had idle capacity (photographs)	Anneal economically and bottleneck removed	
9.	Inspecting slugs	Inspected manually on ground (Photograph 6)	Introducing machine with conveyor. (Photograph 7)	Inspection more positive and increased output	50% increase in output
10.	Recovery of slugs	Wider strips	Narrower strips by adjusting side guide etc	Increase in recovery	About 4%

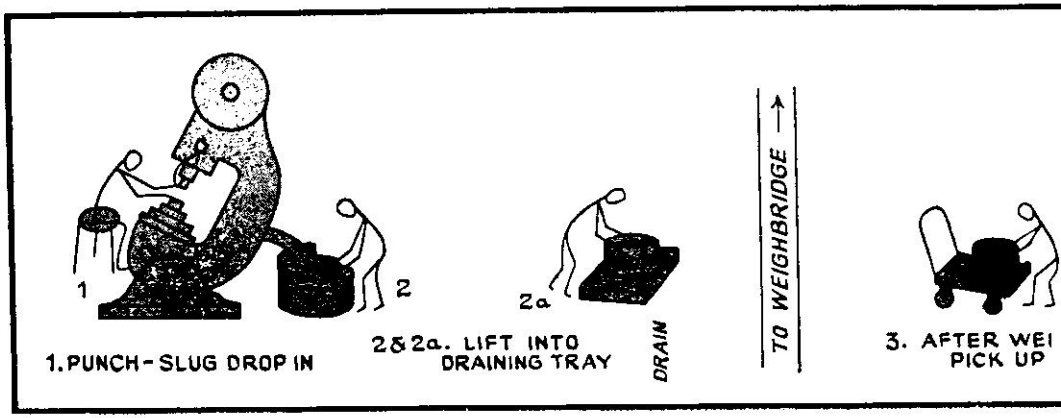
ORIGINAL SEQUENC



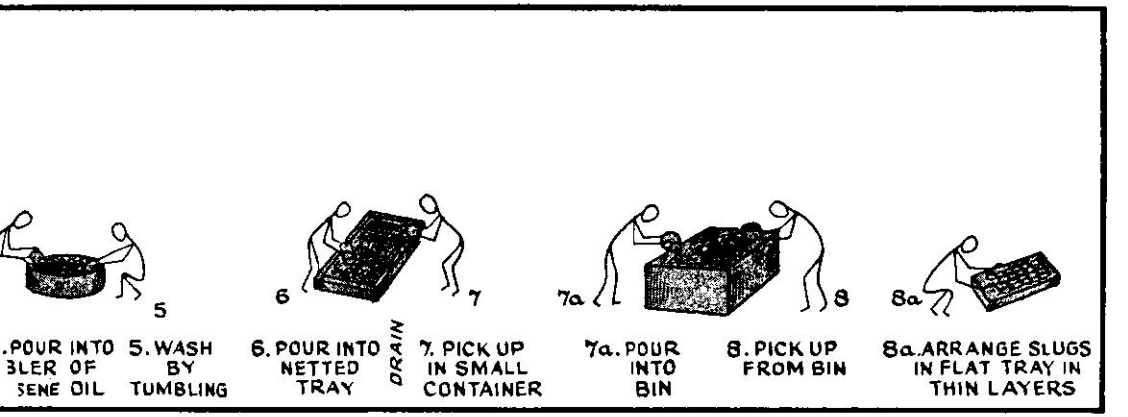
PRESENT SEQUE



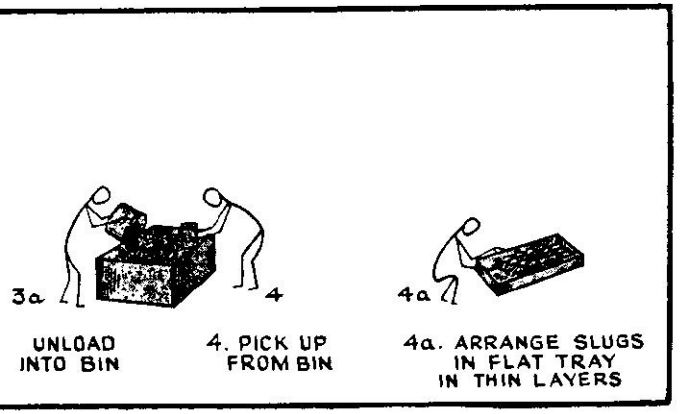
IMPROVED SEQUENCE OF OPERATION



OPERATION



OPERATION



(e) **METHOD STUDY ON HANDLING COILS (Foilstock)**

The edges of coils are found to get damaged during vertical handling of coils. To eliminate this, a project was taken in hand.

ORIGINAL METHOD (Photograph 8)

In this method, coils were handled in the following manner:

1. Coils positioned vertically on annealing rack from their original horizontal position on coil runs.
2. Coils after annealing made horizontal with a rod on the rack.
3. Unloaded on stillage from annealing racks horizontally.
4. Vertical positioning on stillage by manual handling.
5. Transport stillage to inspection.
6. Make coils horizontal to inspect.
7. Make vertical for storage on stillage.
8. Transport stillage to warehouse.
9. Make coil horizontal to deliver on lorry.
10. Carry to lorry with crane.
11. Place vertically on lorry.

Number of times coils made vertical or horizontal ... 7

Number of times coils were weighed ... 3

PRESENT METHOD (Photographs 9, 10 and 11)

In this method, annealing trees to anneal them horizontally are used. The present movements are as follows:

1. Coils are placed horizontally on the arms of tree from the original horizontal position on coil runs.
2. The tree with four coils lifted and positioned on the rack.
3. Unloaded horizontally from tree on to stackable pallets after annealing. (photograph 8)
4. Inspect on pallet.
5. Delivery from pallet to lorry.

Resulting Economies:

Coils made vertical or horizontal .. .. ONCE

(Damage of edges thus avoided)

Weighment of coils .. .. ONCE

These Experiments in Productivity are only broadly illustrative of the possibilities throughout the whole industrial structure of the Indian Economy.

Budgeting in the Small Plant

FEW techniques are more vital to the sound management of a manufacturing enterprise than budgeting. But many smaller companies unwisely neglect or ignore this simple, effective tool. Yet, smaller companies have a great need for it because of a pressing need for profitable utilization of working capital, and for the development of sound plans for meeting future competition and for expanding.

Business budgets do three things: (1) show preplanned activities for each division of the company; (2) coordinate activities of different departments and divisions; (3) permit control by comparing planned activities and income and expense with actual results.

PROCEDURE FOR SETTING BUDGETS

Budgeting applies to the whole field of management. Therefore, all division heads must be made responsible for planning the activities in their own jurisdictions. In this way, as they set the goals for their individual achievements, they must, necessarily, consider past performance together with realizable efficiency under expected future conditions. These men, after becoming budget-conscious, will usually do all they can to make actual performance match budgeted figures or improve on them, if possible.

THE SALES BUDGET

What products are going to be sold, how much of each one, and when must they be delivered? Answers to these questions are the fundamental points on which the activities of the business will hinge. The sales department must supply these answers. Ultimately, it may be helpful if the expected volume is expressed in units as well as in rupees. And, since most businesses have seasonal cycles, it is usually worthwhile to detail these figures monthly for a full fiscal year.

This is the point at which many budgetary programmes hesitate, stop and are abandoned. Many reasons can be given as to why the sales department cannot possibly forecast because of unavailable facts, unforeseen events, and unpredictable conditions. Nevertheless, a sales budget must be developed one way or another. The effective sales manager makes the best use he can of the information he can get and goes ahead. Of course, it must be expected that variances will develop from the original budgeted figures. Every budget must be accepted on that basis. If such a forecast is not made, the factory manager, the purchasing agent or the treasurer cannot arrange to obtain the needed facilities, materials and capital.

In making his budget, the sales manager will presumably have studied the economic state of the nation, the past performance and future potentialities of the various market areas, and the volume, in units and rupees, which can be reasonably attained with maximum profitability to the company. The final figure will show the total income to the company (disregarding minor items such as the sale of scrap). As soon as the sales-volume budget is completed, the sales-expense budget must be prepared. It should show the complete amount of proposed expenditures —by item—which will be required to

advertise, sell and distribute the budgeted volume of products.

It should be noted that in the preparation of all budgets, the future revisions—as well as the procedures used in costing and pricing—will be simplified if items of fixed expense and of variable expense are listed in separate classifications. In the fixed-expense group would be such items as executive salaries, real estate taxes, or building rent, which are essentially the same over a period of time regardless of the volume of operations. On the other hand, variable-expense items would include direct labour and materials, transportation, and machinery power, which vary directly with the amount of business the plant does. Careful classifications of this sort make it possible to calculate break-even points, and to forecast expenditures and company profits at varying levels of production.

THE MANUFACTURING BUDGET

The sales-volume budget should be given to the head of the manufacturing department, whose function is to turn out the goods required by the sales department, at a minimum cost and on specified delivery dates. Without the sales-volume budget, it would not be possible to accomplish these objectives.

It rarely happens that despatches are uniform in quantity throughout the year; hence, the manufacturing department may operate at times at an entirely different level from the current sales volume. Operations, particularly in mass-production shops, must be carried on at a level which utilizes the machinery efficiently, keeps the labour force intact without excessive turnover, and provides an adequate, yet not excessive inventory of finished goods from which despatches can be made according to desired delivery dates. In jobs, of course, where production is almost exclusively on order, finished goods inventory presents no problems and manufacturing operations follow sales very closely. After taking into account all such related details, a manufacturing-volume budget is developed.

Although, typically, the use of materials and supplies is controlled by the manufacturing division, the question of the price of these items must be settled elsewhere. For this reason it becomes necessary to make the purchasing budget concurrently with the manufacturing budget.

THE PURCHASING BUDGET

After considering the existing raw material inventories, anticipated production, and desired inventories, in the light of the probable future prices of major items of material and supplies, the purchasing agent is able (perhaps in collaboration with the factory manager) to set up a purchasing budget. Subsequently, it will become a part of (a) the manufacturing budget which thereby becomes really a complete cost of manufacturing budget and (b) the financial budget. Clearly, it must be reflected in the latter because cash must be available at certain dates to pay for these purchases.

THE FINANCIAL BUDGET

All of the foregoing budgets then go to the treasurer or controller. He combines them, and adds sundry items of income or expense (for example, money received from rented property, royalties paid or received, insurance premiums payable, and the like). He must also compute taxes and show the payments which must be made on specified dates. It is then possible for him to make a tentative statement showing the cash position at the end of each forecasted month. By the same token, he can estimate how much money, if any, must be borrowed, and the probable cost, or how much can be invested for the long or short term. With all financial credits and charges included, the master budget is finished giving a complete picture of

planned activities and results which should be accomplished by the campany as a whole in the ensuing period.

BUDGETARY CONTROL

Each time monthly statements are drawn up by the accounting staff, a summary sheet can be made showing actual results of operations, budgeted amounts, and percentages of budget attainment. Variations will, of course, be noted. But any discrepancies can be immediately investigated, and steps for improvement taken when necessary. A major continuing deviation, which seems to be indicative of a long-term trend, might well cause a revision in both the budget and management thinking. [1]

1 Digested from *Management Aids for Small Business*, Annual No. 1, January 1955, Small Business Administration, Washington, D.C.

JOYS OF AN EXECUTIVE

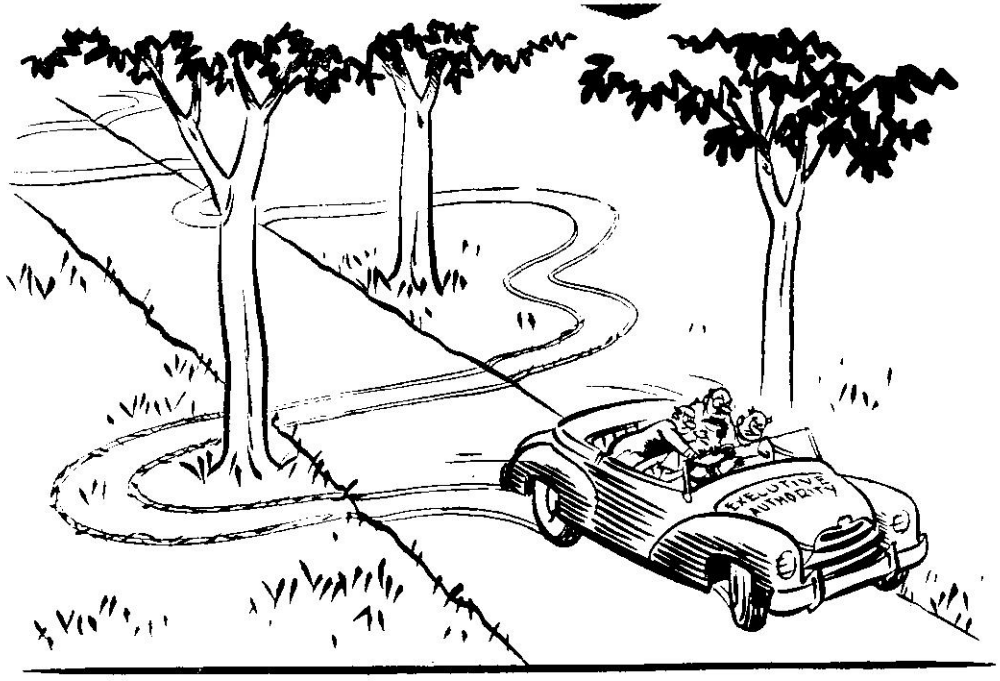
Executives are a fortunate lot. For, as everybody knows, an executive has nothing to do. That is, except:

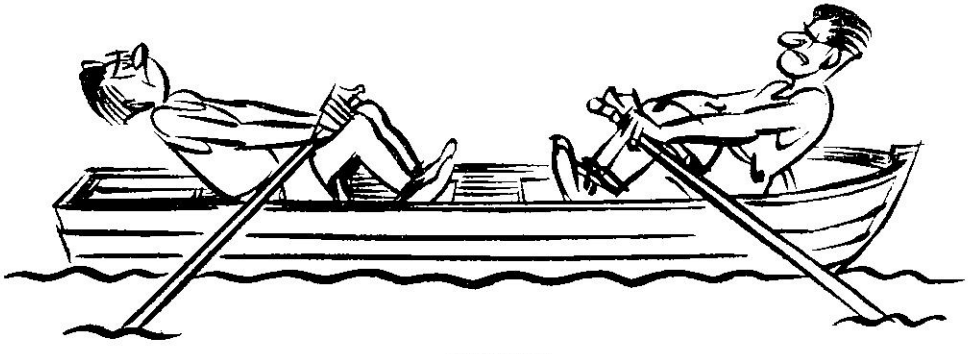
To decide what is to be done; to tell somebody to do it; to listen to reasons why it should not be done, why it should be done by somebody else; or why it should be done a different way; and to prepare arguments in rebuttal that shall be convincing and conclusive. To follow up to see if the thing has been done; to discover that it has not been done; to inquire why it has not been done; to listen to excuses from the person who should have done it and did not do it; and to think up arguments to overcome the excuses.

To follow up a second time to see if the thing has been done; to discover that it has been done but done incorrectly; to point how it should have been done; to conclude that as long as it has been done, it may as well be left as it is; to wonder if it is not time to get rid of a person who cannot do a thing correctly; to reflect that the person at fault has a wife and seven children and that certainly no executive in the world would put up with him for a moment; and that, in all probability, any successor would be just as bad or worse.

To consider how much simpler and better the thing would have been done, had he done it himself in the first place; to reflect sadly that if he had done it himself he would have been able to do it right in twenty minutes but that as things turned out he himself spent two days trying to find out why it was that it took somebody else three weeks to do it wrong; but to realize that such an idea would have had a highly demoralizing effect on the organization, because it would strike at the very foundation of belief of all employees that an executive has really nothing to do.

LET ONE STEER





DEADLOCK

The NPC

WITHIN less than two years of its life, NPC has entered the phase of consolidation. The demand for productivity services having been created, NPC has to arrange not only for the supply of techniques, but also for their application at plant level. Special emphasis is, therefore, being laid on training programmes which will now lend an added dimension to the productivity drive in the country. Considerable thought has been given by NPC specialists for some time past to developing training programmes in the country in various subjects of productivity to suit various levels in industry. An effort is being made even at university level to get the subject of Productivity introduced in college syllabus for appropriate courses. With this end in view, a series of lectures by NPC specialists are being delivered at the Polytechnic, Delhi.

NPC has developed an Appreciation Course and also an intensive Application Course in Work Study. The Course embraces the techniques of Method Study and Work Measurement, and aims at acquiring the best possible results out of available resources. Representatives of both employees and employers participate in these courses.

The first six-week session of the Work Study Course was held under the auspices of the Delhi Productivity Council. A fairly large number of people—industrialists, managers, supervisors and trade unionists—participated in the Course. The second session was held at Faridabad under the auspices of the Faridabad Productivity Council. Arrangements have been made for introducing these basic courses in Work Study in other parts of the country.

To follow up the training imparted in the Work Study Course, NPC is developing similar courses in the following industrial engineering subjects: (i) Time Study, Incentive Plans; Job Evaluation and Merit Rating; (ii) Production Planning and Control, Cost Control and Materials Control; (iii) Quality Control; and (iv) Plant Maintenance, Machinery Replacement, etc.

A Junior Managers course has also been developed to broaden the knowledge and outlook of the Middle Management group in respect of basic managerial subjects. This course deals with various subjects, such as: (i) Philosophy of Management; (ii) Human Factors in Industry; (iii) Leadership in Industry; (iv) Self-improvement; and (v) Developing employees, selection and training etc.

It is intended to supplement the above course by holding one-day seminars on specific techniques and tools of management. The seminars will cover, among others, the following subjects: (i) Joint Consultation; (ii) Stock Control; (iii) Cost and Budgetary Control; (iv) Quality and Waste Control; (v) Sales Management; (vi) Productivity Measurement; (vii) Information & Public Relations; (viii) Economics and Business; (ix) Industrial Relations; and (x) Industrial Legislation.

An integrated and intensive Application Course has been developed with a view to impart supervisory personnel a fairly thorough knowledge of their responsibilities, duties, tools and techniques and their application.

The consolidation phase of NPC must

appropriately begin at the ground level of Local Productivity Councils. With this object in view, certain training schemes, in addition to the above programmes, are being operated through LPCs. Following is a brief account of LPC activities, particularly in the field of training.

Madras Productivity Council has had, during the last few months, quite an intensive programme of activity: (a) An Application Course in Materials Handling conducted by Mr. R L Mitchell, ILO Expert attached to NPC; (b) a 3-day course on Employee Selection and Placement conducted by NPC Specialists and Prof. A Hafeez of the Department of Psychology, Mysore University; (c) a seminar on "Management Accounting"; (d) a symposium on "Role of Labour in Increasing Productivity" presided over by Sri S V Ramamurthy, ICS, Adviser, Planning Commission. Following participated in the symposium :

Sarvashri

Thomas H Holleran, John E Cullerton, Harry H Pollak — (Labour Experts of USA)

VS Shankar, MK Raju, VS Rastogi — (Employers' Representatives)

SCC Anthoni Pillai, K Gurumurti, N Thiagarajan — (Labour Representatives)

(e) A symposium on "Sharing of Benefits of Productivity" inaugurated by Sri M Bhaktavatsalam, Minister for Home Affairs, Government of Madras.

For the three months ending January 1960, Madras Productivity Council has a fairly substantial programme, much of which would have been accomplished by the time this Journal is printed: (a) Training Course in Work Study; (b) Worker's Appreciation Course in Productivity Techniques (in Tamil) for Trade Union Leaders; (c) a 'Labour Seminar'; (d) a seminar on "Human Problems in Management" to be addressed by Mr. John Marsh, Director, Industrial Welfare Society of the UK (23 November); (e) a meeting to be addressed by Mrs. Mary Cushing Niles, Management expert of USA.

Madras Productivity Council has also formed two Circuit Schemes to study (i) Selection, Placement and Training and (ii) Safety Measures which have already started operating.

Other LPCs have not been less active. Coimbatore Productivity Council activities for the past few months are worth mentioning: (a) a two-day seminar on "Employee Selection and Placement" held in collaboration with the Institute of Management, Coimbatore; (b) another three-day seminar on "Incentives for Higher Productivity" conducted in collaboration with SITRA and Institute of Management. The programme of the seminar was :

Subjects	Speakers
Financial and non-financial incentives.	Prof R Natarajan
Incentives for Direct Workers.	Sri HC Ramanna
Incentives for Indirect Workers.	,,
Incentives in Textile industry.	
Incentives in Engineering Industry.	Sri S Ramalingam
Do Incentives intensify Worker's Burden?	Sri TS Ramanujam

In the coming months, Coimbatore Productivity Council proposes to organise the following programmes :

(a) Cost Control Course with special emphasis on Textile Industry; (b) Workers' Appreciation Course in Productivity Techniques (in Tamil); and (c) Work Study.

Salem Productivity Council recently organised a seminar on Higher Management. Programme of the Seminar included the following :

Subjects	Speakers
1. "Management Organisation—Principles and Practices".	Sri K Swarup, Chief Mechanical Engineer, ICF, Madras.
2. "Management Techniques for Higher Productivity".	Sri P L Kumar, Director, Amalgamations P. Ltd., Madras
3. "Management Statistics".	Sri S K Ekambaram, Head of the Dept. of Statistics, Mysore University, Mysore.
4. "Labour's attitude to Increase of Productivity".	Sri T S Ramanujam, President, P&T Employees' Union.

The Council has a programme for organising training courses on Inventory Control to be followed by "Conference Leadership" and a Study Team to study productivity techniques in general in collaboration with Tiruchirapalli Productivity Council. A Circuit Scheme on "Safety & Welfare Measures" has been formed by Salem Productivity Council and the questionnaire and itinerary have been finalised.

Andhra Pradesh Productivity Council recently organised a one-week training course on "Production Planning and Control". The course was conducted by NPC specialists. The Council is organising the following training courses and seminars: (i) a five-week SQC Training Course beginning in November, (ii) training in Work Study, beginning in the last week of January 1960 and (iii) a seminar on "Higher Management" during the second week of December 1959. The Council has also finalised its programme of the first In-country Productivity Team on "Industrial Management."

Tiruchirapalli and Madurai Productivity Councils were recently inaugurated by Sri M Bhaktavatsalam, Minister for Home Affairs, Government of Madras. The Madurai Productivity Council held a group discussion on "Quality Control" and a training course on Production Planning and Control at Madurai.

Sri M M Shah, Union Minister of Industry, and President of NPC, addressed the representatives of Mysore State Productivity Council at Bangalore. The minister exhorted the members to contribute their maximum to the working of LPCs which alone, he said, would strengthen the Productivity drive in the country. He stated that LPCs would have adequate representation on NPC and its Governing Body with a view to maintaining an effective coordination between them.

A seminar on Labour-Management Relations was held under the joint auspices of Mysore State Productivity Council, Indian Institute of Science and ILO Asian Field Office. Following experts participated in the Seminar which was presided over by the Acting Director of ILO Asian Field Office:

(i) Mr. Anwar Shaheed, a senior officer of the Labour-Management Division of the ILO; (ii) Mr. H W Buttner, Departmental Head of the Staff of the Confederation of Trade Unions of the Federal Republic of Germany; (iii) Mr. H R Premer, an expert on Labour-Management Relations, nominated by the Confederation of Employers' Associations of the Federal Republic, Germany.

The Council has arranged the following programme for Mr. John Marsh :

Lecture in "Executive Development, patterns and Practices."

Seminar on "Human Relations"

Public Lecture.

Talk Discussions on Human Relations.

Mysore District Productivity Council recently organised the following activities: (i) seminar on "Personnel and Productivity." (ii) a Four-day Course on "Human Relations Training" for Supervisors at Mysore. The Course covered following subjects: (a) Responsibilities of Supervisors. (b) Supervisory Leadership. (c) Motivation and Morale. (d) Suggestion Scheme. (e) TWI. The Council was scheduled to hold a seminar on "Location of Industries in Mysore City" in November. Two In-country subject Study Teams on (i) Selection and Recruitment and (ii) Marketing have been formed.

A Work Study course was recently arranged at Cochin under the joint auspices of the Kerala State Productivity

Council and the Kerala Institute of Management.

Prof. R Natarajan, Head of the Department of Industrial Engineering and Administration, Indian Institute of Science, Bangalore, gave a talk on "Management Training in United States and Europe," at a meeting held under the auspices of KSPC and the Kerala Institute of Management.

Indore Productivity Council is likely to be inaugurated in the near future. Meanwhile it has drawn up the following programme of activities: (i) Appreciation Course on Methods Study to be conducted at Indore for Top Management. (ii) Short Course on "Cost Control." The Council also proposes to organise a circuit tour to Ahmedabad Textile Mills to be arranged by ATIRA and the Federation of Industries at Ahmedabad.

Ludhiana Productivity Council organised a short Appreciation course on Methods Study for top and middle management. The Council's schedule is as follows: a short course on Cost Control—16 November to 19 November, 1959; basic course on Work Study—end of February to end of March 1960. The Council has taken preliminary steps for organising In-country Productivity Teams.

A two-day Conference on Productivity will be held in the 2nd week of January 1960 under the joint auspices of all the LPCs in the Punjab. If well-organised, it may become a major event in the productivity history of the Punjab.

Delhi and Faridabad Productivity Councils recently completed a 9-week basic Work Study course. A similar course will be started by Kanpur Productivity Council in December 1959, and Dalmianagar Productivity Council in February 1960. The Delhi Productivity Council has also on its schedule a seminar on "Human Relations in Management" in which Mr. John Marsh is to participate. The Council has drawn up a programme of in-country productivity teams. A beginning is being made by sending a team to Calcutta industries. In collaboration with the TWI centre, Bombay, Rohilkhand Productivity Council recently organised a course on "Conference Leadership."

An advanced 14-week Work Study Course was organised by the Productivity Centre, Ministry of Labour and Employment at Bombay under the joint auspices of the Productivity Centre, Bombay Productivity Council and the Institution of Production Engineers. A short one-week course on Stores Reorganisation was also arranged under the auspices of All-India Manufacturers Organisation. Mr. W H Eastman, ILO expert, and a specialist of NPC conducted the course.

Baroda Productivity Council has been fairly active. During October it organised a series of talks, including one on "Human Relations in Industry" by Sri M S Sastry, Manager, Pharmaceuticals, Sarabhai Chemicals. Other talks are listed below:

Subjects	Speakers
1. Practice of Management—some recent developments.	Mrs. Mary Cushing Niles.
2. Materials Control.	Mr. W H Eastman, ILO Expert.
3. Current Work Study Training Course.	Sri M N Unni Nayar, Regional Directorate, NPC.

The Council also organised (i) a ten-week Methods Study Course beginning from October at Baroda conducted by Mr. W H Eastman, and specialists of NPC and (ii) a Rapid Reading Course under the joint auspices of the Baroda

Productivity Council and Baroda Management Association by the Modern Management Association, Bombay.

The Council plans to organise a five-week course (9 November to 12 December 1959) on "Business Management" for entrepreneurs and managers of Small Industries. A Workers' Education Programme is also being considered.

The formation of Kutch-Saurashtra Productivity Council, with headquarters at Rajkot, has been decided upon at a recent meeting of representatives of industry and labour; and a programme is being formulated. The *ad hoc* committee constituted for the purpose of framing the constitution of the Poona Divisional Productivity Council finalised the draft constitution of the Council. The Committee also decided to organise in-country productivity teams.

The recent programme of Asansol Productivity Council includes (i) A SQC Appreciation Course for Management and Foremen, in collaboration with ISI; (ii) Lectures by Mr. John Marsh on "Executive Development —Patterns & Practices" in the first week of December and (iii) a Seminar on Productivity Team Report in the third week of December.

Dalmianagar Productivity Council has decided to arrange a Work Study Course for Foremen at Dalmianagar in February 1960. The Jamshedpur Productivity Council, which is expected to be registered soon, has prepared a programme of a two-day Conference on "New Techniques of Management" and "Human Relations in Management," on the occasion of the visit of Mrs. C. Niles. Another conference was to be addressed by Mr. John Marsh.

Assam Productivity Council proposes to organise two training courses on (i) Human Relations and (ii) Cost Accounting and Cost Control in November and December. The course will be conducted by NPC specialists.

The above account shows that things are beginning to move and something may be expected.

On the other hand, various institutions which deal with subjects related to industrial productivity are increasingly stepping up their activities. Following details show that the productivity drive, undertaken by NPC, is well sustained by allied organisations.

The Institute of Management, Banglore, recently organised talks, listed below:

Subjects	Speakers
1. Human Relations and the Role of Managers	Prof. Zaleznik, Associate Professor of Business Administration, Harvard University, USA. Prof. R Natarajan.
2. Scientific Research in India	Sri M S Thacker, Secretary, Ministry of Scientific Research and Cultural Affairs, Government of India Dr. S Bhagavantam, Director, Indian Institute of Science, Bangalore.
3. Changing Practices of Trade Unions	Sri S. Guruswami, President of Indian. Railwaymen's Federation. Mr. John S. Fox, Director, ILO Asian Field Office, Bangalore.

The Institute proposes to hold a Seminar on "Personnel Management Trends" to be addressed by Mr. John Marsh.

The Madras Institute of Management recently organised meetings and conferences on the following subjects:

Subjects	Speakers
1. Salesman	Mr. T O Caulkins of Standard Vacuum Oil Co. Sri P P Mullick of Hindustan Lever.
2. Usefulness of Works Committees in Industries	Sri S K Parthasarthy of Burmah Shell Oil Company.

The Institute also organised two other meetings recently which were addressed by Prof. Zaleznik, and by the USA Labour Mission which was on a visit to Madras.

A meeting, addressed by Mr. John Marsh was arranged by the Institute at Madras on 23 November. The subject of talk was "Executive Development".

The South India Textile Research Association organised a three-week "First Course in Work Study", beginning from 21 September. Sitra also held a symposium on "Productivity of Labour in Textiles" in September.

In collaboration with the LPC, the Institute of Management, Coimbatore, organised last September, a seminar on "Employee Selection and Placement." It was addressed by Prof. A Hafeez of the Mysore University. Attention was focussed on such aspects as psychology tests in recruitment, interview techniques, initial training to be imparted at the time of recruitment, induction of an employee and his follow up in the organisation etc.

The Ahmedabad Textile Industry's Research Association (Atira) held a three-day "Technological Conference" in October at Ahmedabad. It was inaugurated by the Union Minister of Industry, Sri Manubhai Shah. The Conference covered a wide variety of subjects: Structural Imperfections in Fibres; Problems in Cotton Breeding for Better Fibre Quality; Opening and Blending of Cotton; Physico-chemical aspects of Dyeing, Carding, Drafting and Spinning; some Modern Finishing processes, and Future of man-made fibres in blending with cotton.

SQC Unit, Delhi, organised a 2-week training programme on Statistical Quality Control at Delhi, beginning from 27 September 1959. The programme was inaugurated by Sri Manubhai Shah, President of NPC, and presided over by Sri C D Deshmukh. The meeting was also addressed by Executive Director of NPC and Sri B D Kapur, General Manager of the Atlas Cycle Works, Sonepat.

Mazdoor Seva Sangh, Kanpur, organised a meeting of Trade Union Workers of UP on 20 September 1959. Officer-in-charge, NPC Regional Directorate, gave a talk on "Labour's Role in Productivity Drive." The meeting was attended by about 60 trade union workers. The Sangh was scheduled to organise a Labour Conference on "Productivity" in November last.

The Textile Association of India, Indore Branch, recently organised a seminar on Productivity at Indore. Two specialists of NPC gave talks on "Need for Productivity Drive and Techniques of Productivity" which were followed by a lively discussion.

Labour Department, UP, recently organised a 10-day Conference on "Techniques of Productivity." An exhibition on "Cost Control" was arranged by NPC and some productivity films were shown on the occasion.

A seminar on "Trends in Human Relations and Welfare Schemes" was scheduled to be held on 15 November 1959, under the auspices of the Tata Institute of Social Sciences, Bombay. Mr. John Marsh was to be the principal speaker at the Seminar.

Last October, Ahmedabad Management Association organised a talk on "Management function in Corporate Sector" by Sri D L Majumdar, ICS, Secretary, Company Law Administration, Government of India. Mrs. Cushing Niles gave a talk, on 19 October, on "Human Relations — The clash of opinion" under the auspices of the Association. Mrs. Niles gave another talk on "The Managerial Problems in a Developing Economy" under the auspices of the Bombay Textile Research Association.

The Indian Institute of Personnel Management, Calcutta, recently organised the following courses, seminars and talks:

(i) Refresher Course for Personnel Managers (ii) Job Relations Course for Supervisory Staff (iii) A Conference Leadership Course for Middle Management (iv) A Seminar on the subject of Works Committees (v) A talk on "Promotion of Craftsmanship" by Mr. S A Horton, ILO Expert. The Institute has plans to conduct a Seminar on the report of the first Indian Productivity Team with a view to considering the recommendations made in the report, particularly in the field of Industrial Relations.

The Indian Statistical Institute, Calcutta, conducted a course in Quality Control for Middle Management. It was attended by representatives of different industrial units. The Institute will conduct an Appreciation Course in Asansol in the last week of December under the auspices of the LPC. The Quality Control Unit, Calcutta, will conduct a Seminar on the Productivity Team Report, with a view to discussing and considering the recommendations, particularly in the field of Quality Control and Standardization. The Institute also proposes to organise a Seminar on the Productivity Team Report to consider the recommendations made therein, particularly in the field of "Management Organisation & Control." The Institute of Cost and Works Accountants, Calcutta, will conduct Training Courses on Cost Accounting, Cost Control and Cost Reduction in the near future. Among other programmes of the Institute are (i) Research on industrial productivity and (ii) Training Courses for Government Officers and staff nominated by different State Governments with a view to giving them preliminary knowledge about Cost Accounting and Cost Control. The Institute of Production Engineers, Calcutta, organised a lecture on "Education for Industrial Engineering," which was followed by a lively discussion.

The Institute conducted a Seminar on the First Productivity Team Report on 28 November. The Jute Technology Centre, Calcutta, organised a Seminar on "Waste Control in Jute Industry." A Seminar on Productivity Team Report was to be held by the Centre on November 13. The Imperial Tobacoo Co. Ltd., organised a training course on Quality Control in collaboration with ISI for Middle Management of their different units in October. The Indian Aluminium Co. Ltd., Calcutta had recently a one-week Seminar on "Employee Relations" and the following subjects were discussed: Discipline; Grievance Procedure; Employees' Attitude towards Agreements and Contracts; Communications; Tools of Productivity and Legal Aspects of Discipline.

Phillips India Ltd., Calcutta organised a Course of training for their junior management personnel on the following subjects: Organisation; Elementary Accountancy; Costing and Pricing; Statistics and Graphics; Market Research; Advertising; Personnel and Human Relations; Planning; Forecasting and Budgeting; and Product Knowledge.

Small Industries Service Institute, Calcutta, recently conducted a five-week "Business Management Training Course". The Institute also conducted a five-week Business Management Course at Asansol for small Industrialists of that area.

NPC is trying its best to see that our industrialists get some idea of Productivity Techniques in advanced countries. In that connection, Teams are being sent abroad for short periods with TCM assistance. Recently the Management Organisation and Training Team and the Coal Mining Industry Team returned to India after 7-week tour abroad. The 12-Member Road Transport Industry Team led by Sri D S Rathor, Transport Commissioner, left on 17 October. The

Team is visiting West Germany, the UK, the USA and is expected to return to India via the Pacific by the end of December. Factory Building Layout and Construction Team left on 1 November. The Team consists of 13 members, led by Sri Sarup Singh, Chief Engineer, Plan Projects, Planning Commission. It visited Japan before proceeding to the USA and Italy. With the departure of this Team, the scheduled programme of seven Teams for current year, has been completed. A large number of suggestions regarding composition, problems of study and itinerary of the teams to be sponsored by NPC under TCM aid for the next US fiscal year (July 1960 to June 1961) have been received and are being examined.

31 out of 40 trainees for the award of TCM Fellowships have already left India for the USA and the UK for training in various fields of Productivity. The remaining trainees are likely to leave in January 1960.

NPC has received 1,050 applications in response to its press advertisement and circular letters addressed to various organisations Chambers of Commerce and Central|State Governments for 50 TCM fellowships to be sponsored during the US Fiscal Year 1960-61. These applications are being scrutinised and final selection of candidates will be made in January 1960.

Selection of candidates for the award of 20 French Fellowships for training in Scientific Management has been finalised. The candidates are likely to leave in January 1960.

More important in a way, and with greater possibilities, is the scheme of In-Country Productivity Teams, which has been approved by the NPC Governing Body. It is possible to organise a campaign for increasing productivity through a large number of in-country Productivity Teams conducting intensive studies and stimulating exchange of technical information within the country. The In-country Productivity Teams include subject study teams as well as industry teams. Each team will consist of 10 persons and will include representatives of workers, technicians, employers from the public and private sectors etc. Detailed instructions have been sent to Regional Directorates for implementing the programme. Communications have also been addressed in this connection to Associations of Industries, Trade Unions, State Governments, Local Productivity Councils etc.

NPC has already received very encouraging response from organisations of industries and individual industrial establishments, suggesting Teams in various industries and subjects of study. Suggestions have been received from LPCs and other organisations for Industry Teams on cement, rayon, cotton and textiles, pharmaceuticals, automobiles, radio, jute, heavy and light engineering, coal, sugar, chemicals, bicycles, shoe-making, handloom, woollen textiles, ceramics, handicrafts, paper, printing, transport, plastics, rubber, hosiery, soap and optical industries. In addition, suggestions for organising Subjects Study Teams on Incentive Schemes, Materials Handling, Welfare and Labour Participation in Management, Cost Accounting, Safety Packaging, Communications etc. have also been received.

NPC specialists in the Regions have established contacts with a large number of industrial units and interested them in productivity techniques. A number of units have also approached the NPC Regional Directorates for assistance in introducing Productivity Techniques.

The stage is thus set for a massive advance in productivity, if we can, with faith and determination, marshal resources towards that end—an end, which, in all conscience, should rank the highest in the country's Plans and Projects of Economic Development.

National Productivity Programmes*

In February and March 1959, a Technical Meeting on Problems of Productivity Improvement in Certain Countries was held in Bangalore in accordance with decisions taken by the Governing Body of the International Labour Office at its 140th Session (November 1958). Participants came from India, Indonesia, Iran, Israel, Japan and the Federation of Malaya and included directors of national productivity centres or institutes and leaders from both sides of industry as well as the chiefs of two ILO productivity missions under the Technical Assistance programme. The meeting unanimously adopted conclusions in the form of recommendations concerning the preparation, organisation and execution of national productivity programmes.

TO be fully effective a national productivity programme must be designed to meet the specific needs of the country concerned. Productivity programmes should accordingly be closely co-ordinated with over-all programmes of economic development. As a basis for such co-ordination there should be close consultation between the authorities responsible for the national productivity programme and the authorities responsible for drawing up or for supervising the execution of the national economic development programme.

Social traditions in all countries play a significant part in promoting or retarding the growth of productivity. In countries embarking on programmes of industrialisation, attitudes carried over from a non-industrial society often continue to influence the thinking and the actions of employers, managers and workers in industrial organisations and to impede the development of fruitful co-operation between labour and management. If a programme of productivity improvement is to be fully effective, intensive efforts should be made by all concerned to change these attitudes to ones more appropriate to effective industrial operation without, at the same time, injuring those traditions which give to the various cultures their characteristic virtues.

Special consideration should be given in all national campaigns for raising productivity to the role of workers and trade unions, since their interests are immediately affected and their co-operation is essential to success.

While it is agreed that, in the long run, the widest possible attainment of higher productivity will benefit all members of a community, there exists no infallible method of ensuring that employees in any individual undertaking, private or public, will benefit directly in the short term. Nevertheless, experience has shown that, in practice, no attempt to increase productivity has any chance of lasting success unless those on whom it depends receive some tangible benefits from it within a reasonable period of time.

Some redundancy may be unavoidable when measures to increase productivity are introduced into the individual enterprise. Governments and employers should take steps to minimise or mitigate this problem. Steps to increase productivity within the fac-

* Abridged from International Labour Review, Vol. LXXX, No. 2, August 1959.

tory or workshop should not be taken independently from other management actions. Before initiating projects for raising productivity, employers should endeavour to assess as accurately as possible the probable effects on all aspects of the operation of the enterprise, such as volume of sales, requirements for different skills, the ratio of direct to indirect workers, the nature of the administrative and clerical work and the requirements for production staff. Reorganisation on a factory-wide scale is bound to take considerable time, and careful analysis may reveal future needs for new types of skills, manual and clerical, for which personnel can be selected for training as required.

The attention of governments is specially drawn to the possibilities of improving the productivity of manual workers in certain types of operation, notably digging and earth-moving, so as to render the cost of such labour cheaper and thus make its use more advantageous in comparison with the use of machinery. In countries where irrigation schemes, prevention of soil erosion, road building and similar activities are required on a large scale, not only can the requirements for imported foreign machinery be reduced by this means, but, where unemployment and underemployment exist, this may prove a means of providing more employment for agricultural and unskilled labour, thus enabling a greater volume of essential work to be done at the same total cost and reducing the numbers unemployed.

In assessing the possibilities of increasing productivity, employers and managers should consider the problem in its widest aspects. In many industries, raw materials represent the greatest cost item in the finished product. It is often the case that the saving of a small percentage in the materials cost of a unit of product may be the equivalent of a large percentage saving in labour cost. In many countries raw materials have to be imported and are frequently scarce. It is evident that better utilisation of materials may enable overall costs to be reduced while at the same time making available a greater output of finished products from the same quantities of material. In the same way, in many countries, machinery may have to be imported at a high cost in scarce foreign exchange. The fullest possible utilisation of this machinery is essential if costs of manufacture are to be reduced and the maximum output achieved. It may sometimes be profitable actually to increase the number of workers employed in tending or servicing this machinery or plant in order to obtain optimum output.

Attention is drawn to the need for good maintenance of all plant, machinery and equipment if the optimum productivity of these resources is to be obtained. A frequent cause of low productivity of plant and machinery is the difficulty of obtaining spare parts due to the high rate of usage and import restrictions. Breakdowns and the excessive consumption of spares may be substantially reduced by proper training of all workers operating and maintaining machines. In this connection, direct workers displaced through the application of work simplification may often be retrained to provide more adequate maintenance and cleaning services for plant and machinery.

Many undertakings lack adequate ancillary services such as inside fire protection, safety precautions and cleaning. Suitable workers displaced from other jobs may be retrained for these services.

It may be concluded that if proper planning and study are undertaken from the very outset of any campaign to increase productivity, individual hardship can be kept to a minimum and job opportunities may often be increased.

The intial stages of a productivity improvement programme are of parti-

cular importance; intensive publicity and promotional activity may have to be used to awaken the interest of industrialists, workers and the general public. Publicity should be given to cases of increased productivity achieved within the country itself, with emphasis on the benefits derived from them. Both individual and national benefit should be stressed (e.g., increases in the earnings of workers, or savings in foreign exchange due to savings in the use of imported raw materials.)

In the conduct of a productivity programme it is important to enlist from the outset the active support and participation of persons in the highest circles of the government, the administration, industry and trade unions, and to ensure that that support is maintained.

Whether the productivity centre or any other institution responsible for promoting the improvement of productivity in any particular country is to be a governmental or non-governmental agency must depend on the circumstances of the country concerned. It is, however, essential that the fullest possible government support should be given at all times, and it will generally be necessary for the government to provide a substantial amount of finance, at least in the initial stages of the life of this institution.

It is generally considered desirable that, even where the staff of a productivity centre are government officials, the centre should have a governing board composed of representatives of the various interests concerned. Whatever part the government may play in financing, staffing or otherwise assisting the productivity centre, it is not usually desirable that the government should control its day-to-day policy or that it should be regarded purely as a government department. Having regard to the close relations it will need to maintain with industry, the centre should wherever possible enjoy at least some measure of autonomy or independence.

National productivity centres will vary in their constitution, staffing and the scope of their activities according to the needs and degree of development of the country concerned. In countries where a number of professional, educational and other institutions dealing with different aspects of productivity improvement already exist, the productivity centre should undertake or assist in the co-ordination of their activities in this field in order to ensure that there is no wasteful duplication of effort and that all resources are used to best advantage. Where such facilities do not exist or are still in embryo, the centre may have to undertake a very wide range of activities, at least in the initial stages.

The activities which may be expected to fall within the scope of a productivity centre may include the following:

(1) publicity and promotional activities in favour of productivity improvement;

(2) programmes of education and development for top and middle management, productivity technicians, supervisors and workers' representatives;

(3) technical information and inquiry services and a reference or lending library;

(4) the preparation (including translation and adaptation) of textbooks, training manuals, films, film strips, etc.;

(5) advisory and consultant services; and

(6) research into problems of raising productivity.

Although the principal services are likely to be centralised at the head office, branches should be set up in the

principal provincial centres as soon as adequately trained staff can be made available. Promotional, educational, advisory and information services should be decentralised as far as possible, a regional flavour being imparted to local activities and appropriate appeals being made to local pride.

From the outset the centre should be the focus of all technical assistance, international or bilateral, in the field of productivity improvement. So long as appropriate facilities for such co-ordination in respect of higher management development do not exist in the universities, technical colleges or elsewhere, the centre may also serve as a focus for assistance in this field.

While noting the importance of training adequate numbers of workers in the various skills which will be required as industrialisation proceeds, the meeting has not attempted to formulate detailed recommendations on this subject, which has been fully covered by other ILO meetings. The meeting does, however, wish to emphasise the importance of utilising the opportunities offered by vocational training courses to make workers productivity-conscious and to encourage them to show initiative and imagination in devising quicker and more efficient ways of doing the work entrusted to them.

The role of the foreman or supervisor is of key importance since he forms the main link between higher management and the workers on the shop floor. Training of foremen and supervisors is therefore an important element in any productivity programme.

Different levels of management, supervision and workers, and different subjects, demand differing forms of presentation. A cardinal rule is to encourage as much audience participation as possible. The following techniques of presentation may be considered valuable at different levels:

(i) *seminars and conferences for employers and top managers*: case studies in general management; discussion groups led by prominent industrialists; lectures on general economic, commercial and personnel matters by persons outstanding in their fields; films; demonstrations in which members of the audience can participate; decision-making activities;

(ii) *seminars and courses for middle management*: case studies embodying various aspects of management; guided discussions in groups; "incidents"; role-playing; lectures on management techniques; films; demonstrations; simple practical exercises in the classroom or laboratory; decision-making activities;

(iii) *courses for productivity technicians and other technical personnel, supervisors and workers' representatives*: case studies; lectures in techniques; demonstrations and practical exercises; "incidents"; role-playing; films; discussions.

Provision should be made for study tours composed of groups of industrialists, managers or workers, or mixed management-worker teams. Such groups should be familiar with current practice in their own country in the general subject field which they are to study and, before their departure, should prepare themselves thoroughly so as to be able to derive maximum benefit from the opportunities provided by the tour.

Labour Productivity in Spinning

T V Ratnam
&
V Ramakrishnan*

A HIGH rate of labour productivity is not a matter of chance. It is the result of the effective utilization of machines, man-power, materials and the technical knowledge at the disposal of Management. Any failure to make full use of one or more of these elements would result in a lowering of output with consequent increase in manufacturing costs. The importance of labour productivity derives from the fact that it provides a general measurement of economy and efficiency in the use of labour, which in cotton spinning accounts for about 25 per cent of the cost of production.

In this paper an industry-wide comparison of 46 member mills of SITRA has been made on the basis of a productivity index in the framing of which care has been taken to eliminate factors, considered irrelevant. Indices have also been evolved to measure the extent to which productivity could be improved under the existing conditions and through such measures as renovation and modernization. Incidentally, this paper assesses broadly the effect of labour productivity on manufacturing costs, the extent to which productivity could be increased in the South Indian Textile Industry etc.

The method most widely used of measuring productive effectiveness is the number of operative hours required to produce 100 lbs. of yarn, which is referred to as OHP. This index is the reciprocal of production per man hour, and has the advantage of being additive for all the processes which contribute to the final product. OHP, however, leaves something to the desired because it is influenced by factors other than that of labour productivity. For example, in the case of the Ring Spinning department, where as much as 70 per cent of the total labour is employed, production per machine varies more or less in relation to count (approximately count $\frac{3}{2}$). Hence, OHP would vary if the average count or range of counts spun differs, with the result that mills would not be able to compare their productivity from time to time and also with their competitors.

In order to eliminate the effect of count, an alternative measure called OHH, that is, operative hours per 1000 hanks of production was subsequently evolved. OHH is also not completely independent of count, in as much as it does not cover the effect of turns per inch, which are different for different counts. OHH varies with $\sqrt{\text{count}}$. The index does not take into account the range of counts spun.

Generally, in finer counts, because of fewer creel changes, less frequent cleaning and better working, it is possible to allocate more number of machines per operative. This factor is not reflected by either of the indices.

In order to eliminate the effect of count, range of counts spun, variation

* The authors are research scholars working for the South India Textile Research Association (Sitra), Coimbatore. Sri Ratnam is Head of the *Liaison* & Statistics Division and Sri Ramakrishnan, Senior Scientific Officer in the same Division.

in work-assignment from count to count, etc., OHP has been converted to a standard count of 40s. This enables a valid inter and intra-mill comparison. For converting to a standard count, the industry-wide work-load agreement[1] and the speeds, *Tpi*, type of processing, etc., prevalent in the South India Mills for processing the various counts were taken as the basis, and a relationship between OHP and count was first established in different departments.

Chart 1 gives OHP for various counts. If OHP were independent of count, a direct comparison between mills would have been possible, but in all sections OHP increases with the count. Chart II shows that OHH also is dependent on the count but, unlike OHP, it tends to decrease as the count increases. From Chart I it is possible to calculate the ratio of OHP of any count with a standard count of 40s. Once this ratio is obtained the "Standardized OHP" that is, OHP converted to a standard count of 40s is obtained from the formula derived here.

Let P_1, P_2, P_3, P_4 be the output in lbs in Ring Spinning in counts C_1, C_2, C_3, C_4 respectively and 0 the OHP. Also let a_1, a_2, a_3, a_4 be the ratios between the OHP of counts C_1, C_2, C_3, C_4 with that of the standard count of 40s respectively. It is required to estimate the OHP for 40s, which we shall assume as H. From the above, it follows that the OHP for counts C_1, C_2, C_3, C_4 are a_1H, a_2H, a_3H, and a_4H respectively. Therefore, the total operative hours employed would be equal to

$$\frac{1}{100}(P_1a_1H+P_2a_2H+P_3a_3H+P_4a_4H)=\frac{H\Sigma Pa}{100}$$

and, $$O=\frac{H\Sigma Pa}{\Sigma P\times 100}\times 100$$

Hence $$H=\frac{O\Sigma P}{\Sigma Pa}=\frac{\text{Operative hours}\times 100}{\Sigma Pa}$$

From the above equation it follows that the Standardised OHP could be calculated by substituting ΣPa fo ΣP. The factor 'a' would be different for different departments and for 40s count the same is unity for all departments.

Once a valid comparison of productivity between mills is made possible, the next important point is to investigate the various causes that affect productivity. Some of the prime factors are :—

1. Quality characteristics of raw material.
2. Work assignment.
3. Type of processing.
4. Machine efficiency.
5. Degree of mechanization.
6. Package size, drafts, speeds, *tpi* etc.

It is very difficult to eliminate the effect of raw materials from the overall industry-wide comparison, and further, if all important factors that are responsible for variation in productivity are eliminated, there would be nothing to compare and the very purpose of the survey would be defeated. The raw material factor has, however, been considered in estimating the extent to which the mills could increase productivity under existing conditions. Regarding other factors, if productivity of a very old mill having obsolete techniques is compared with that of an up-to-date mill, it would be obviously different. Hence, it is essential to evolve indices of productivity that would be a measure of the increase in labour productivity, the increase being effected by either of the following ways:

1. Using the existing equipment to the best advantage.
2. Imposing better conditions, either by renovation or replacement.

To measure the effect of these two factors, a method based on that develop-

1 Classification, Duties and Work-loads in Textile Mills in Coimbatore, The Southern India Millowners' Association, Annexure II, 1957.

Chart I

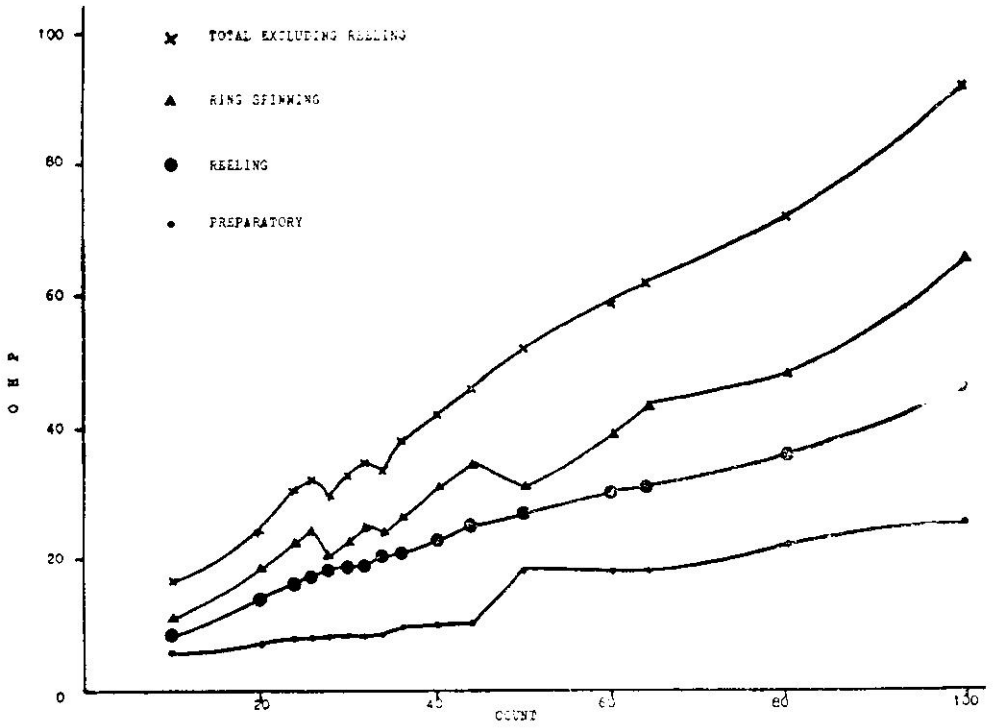
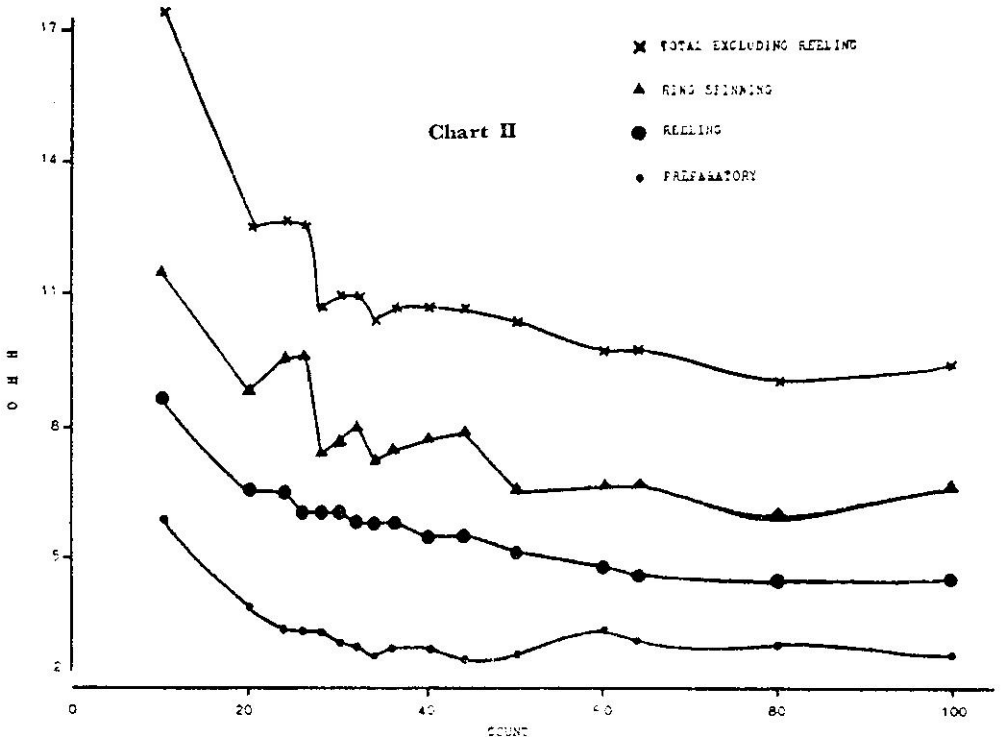


Chart II



ed by Vanden Abeele[2] has been used. The aim of the method is to secure a way of scoring, by which the position of a mill may be established as regards the efficiency of utilization of machinery and obsolescence of equipment.

In taking the maximum out of existing equipment, three important factors arise. The first one is related to the allocation of machines to operatives which would depend upon the rate of end breaks, frequency of stoppages, package size, counts spun, and other such factors. Though in many mills it is possible to increase the number of machines per operative, no attempt has been made here to consider this aspect because of the industry-wide agreement on work assignment. The second factor is whether the optimum speeds and drafts have been maintained or not. This would, for a given type of machine and count, primarily depend upon the condition of the machine and its state of maintenance. It varies considerably from one mill to another, yet for the sake of attaining maximum productivity, it is assumed that the mills would maintain their machines in a satisfactory condition. The third factor is keeping the efficiency of the department at the maximum level. Here it is assumed that all unproductive time would be reduced to a minimum and a standard efficiency of 90 per cent in Cards, 85 per cent in Drawing and Slubbing, 88 per cent in Inter, 90 per cent in Roving and 88-92 per cent in Ring Spinning would be maintained.

In order to estimate how far productivity could be increased as a consequence of the three factors, an index called 'Efficiency Index' has been evolved. An Efficiency Index of 100 means that the best use is made of existing equipment. If it is 90, it is indicative that the present productivity is only 90 per cent of that attainable under existing conditions, or in other words, the mills can reduce the OHP by 10 per cent. The efficiency Index is calculated from $\frac{\text{Expected OHP}}{\text{Existing OHP}} \times 100$, where the Expected OHP is the maximum productivity that could be obtained under existing conditions, and the Existing OHP is that actually obtained.

Higher labour productivity could however be achieved by imposing better conditions. Better conditions have been assessed on the basis of existing practices in mills having high productivity, and they are :

1. Single process Blow Room.
2. Two heads of Drawing.
3. Two passages of Fly Frames.
4. High draft in Ring Spinning, with 6" lift and a spindle speed of 11,000 rpm.
5. Standard raw material.

An index called the 'Productivity Index' has been evolved which would enable mills to know their relative position and also the extent to which productivity could be increased after imposing better conditions. The index is evaluated as under:

$\frac{\text{Improved OHP}}{\text{Existing OHP}} \times 100$, where Improved OHP is the OHP after imposing better conditions. The Productivity Index under the existing work assignment would be a maximum of 100. However, with higher work assignment or improved techniques, the Productivity Index would be above 100. A Productivity Index of 80 indicates that the same quantum of production could have been produced with 20 per cent less operatives. If the Efficiency Index is 90 in the above illustration, it means that the Productivity Index could be increased from 80 to $\frac{(80 \times 100)}{90} = 88.9$, by making a full utilization of the plant, keeping

2 Abeele, A M Vanden, Productivity Measurement Review, European Productivity Agency, Special Number, October 1957.

TABLE I

Inter-Mill Comparison of Standardised OHP, Productivity Index and Efficiency Index.

Group No.	No. of Mills	Standardised OHP		Total	Productivity index	Efficiency index	Productivity index attainable under existing conditions
		Preparatory	Spinning				
1	5	11.91	24.53	36.44	109.7	98.3	111.4
2	2	12.10	29 86	41.96	95.2	97.1	97.9
3	7	13.97	30.48	44.45	89.8	94.0	95.5
4	6	13.26	34.54	47.80	83.5	90.2	92.6
5	5	17.00	33.65	50.65	78.8	89.1	88.4
6	3	15 85	38.06	53.91	74.0	83.5	88.7
7	11	19.70	40.98	60.68	65.8	82.0	80.3
8	4	21.74	44.33	66.07	60.4	79.6	75.9
9	3	23 81	49.14	72.95	54.7	77.1	70.9
Average	46	16.62	36.19	52.82	75.6	87.0	85.3
Standard	—	11 44	28.48	39.92	100.0	100.0	—

the standard efficiency and good machine maintenance and from 88.9 to 100 by imposing better conditions.

A detailed survey of labour productivity of 46 member mills of SITRA was conducted. In each mill the Standardised OHP, Productivity Index and Efficiency Index were estimated. The mills were ranked according to the Productivity Index and they formed into nine groups, each group significantly different from the other. The number of mills in each group and the corresponding figures of the indices are given in Table 1.

The Productivity Index was found to vary to a considerable extent, the seven mills in the last two groups utilizing about 75 per cent more operative hours to produce the same quantum of production. It has been estimated that a unit increase in OHP would approximately increase the cost of production per 100 lbs of yarn by Re. 0.50, thereby increasing manufacturing cost in these mills by about Rs. 0.3 million per annum per mill.

A comparative study of the Productivity Index and the increase attainable under the existing conditions in the nine groups of mills is given in Chart III. The Productivity for the industry as a whole has been estimated to be 75.6 as against a maximum of 100 attainable. This means that there is scope for increase in productivity by 32 per cent for the entire industry. Out of this increase, 15 per cent is possible under existing condition and the remaining 17 per cent by imposing better conditions.

The relationship between Productivity Index and Efficiency Index is illustrated in Chart IV. The two indices are positively correlated, thereby indicating that the scope for increasing productivity under existing conditions is greater in mills where productivity is low. In other words, one of the major causes for low productivity lies in not making effective utilization of existing equipment.

Comparing department-wise, it has been estimated that productivity could be increased by 27 per cent in Ring Spinning and 45 per cent in the Preparatory Department. Variation in Productivity in Ring Spinning could be mainly accounted for by differences in production per spindle per shift of eight hours, the other factors being lift, number of spindles per operative etc. The maximum variation in production in different counts is given in Table 2.

TABLE 2

Variation in production per spindle per 8 hours in ozs.

Count	Minimum	Maximum	% difference
20s	4.06	6.39	57.4
26s	2.96	3.99	34.8
30s	2.24	3.39	51.3
40s	1.60	2.38	48.8
60s	0.90	1.42	57.8
80s	0.70	1.07	52.9
100s	0.59	0.79	33.0

Production per spindle was found to differ by about 50 per cent which could be mainly accounted by variation in machine condition, quality of raw material, type of machine, speeds, machine utilization, etc.

In preparatory department, the difference could be explained mainly by type of drafting in Ring Spinning, the number of passages of Fly Frames and Drawing and type of Blow Room. Table 3 gives the percentage of mills using

Chart III

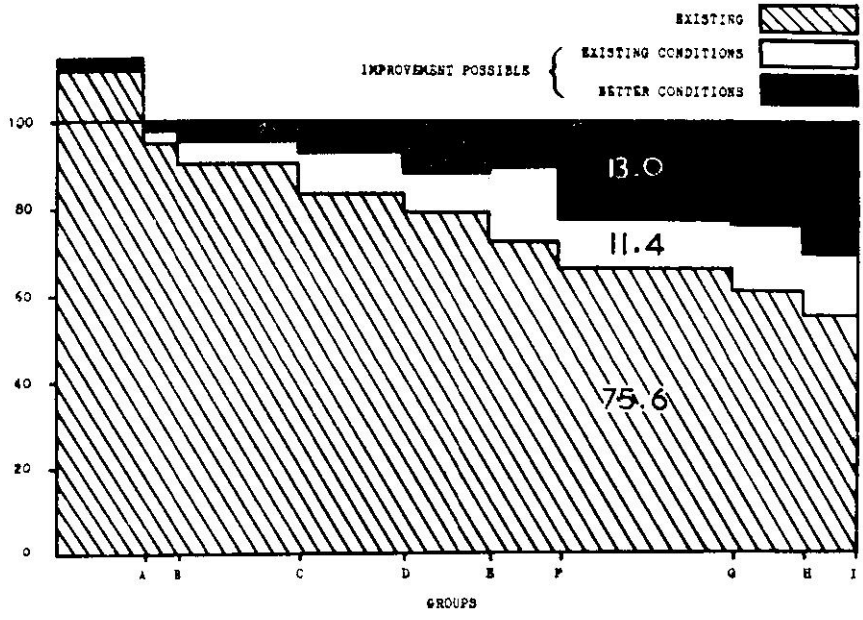


Chart IV

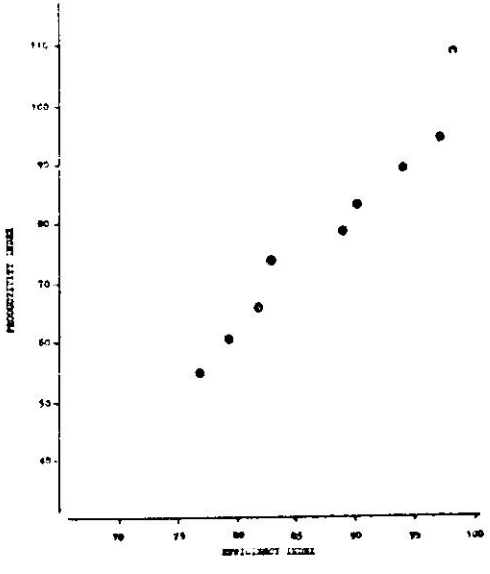


Chart V

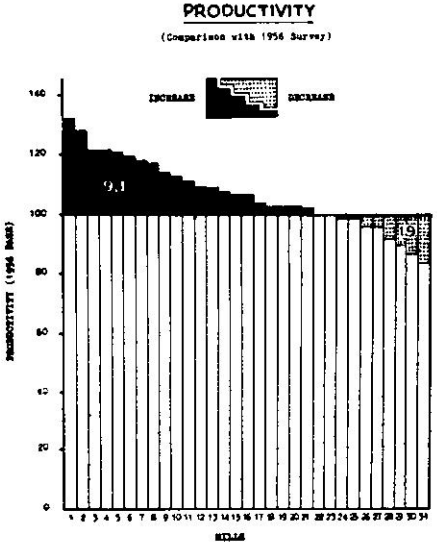


TABLE 3

Type of Processing in fly Frames

Number of Mills %

Counts	Direct from Drawing	One passage	Two passages		Three passage
			Inter feed	Roving feed	
10s to 17s	.. ..	29	42	..	29
18s to 26s	.. 2	34	30	17	17
28s to 34s	.. ..	17	23	23	37
36s to 44s	.. ..	10	29	24	37
50s to 64s	.. 2	17	14	36	31
80s to 100s	.. 8	25	8	25	34
Staple fibre	.. ..	48	23	6	23

various types of processes in Fly Frames, count-wise.

In most of the counts, the conventional type of processing was found to be prevalent in 33 per cent of the cases. For counts below 26s and in staple fibre, the number of instances was found to be slightly less. The two passage system was found to have been adopted in about 50 per cent on all counts up to 80s. Here again in coarser counts more number of mills preferred Inter feed to Roving feed. But as the count becomes finer, a tendency to go in for Roving feed was noticed. Very few mills preferred two passage Inter feed for counts above 80s. One passage was found to be more common in counts below 26s and staple fibre. In 80s — 100s range also, 25 per cent of the mills had one process. Spinning direct from Drawing was very rare, but the preference here is to go in for finer counts.

Whenever an increase in Productivity is contemplated, one important question arises: "What is its effect on quality?" Quality, however, depends upon a number of factors. It is true that high productivity can be achieved at the cost of quality. For example, a very high doffer speed in Cards or spindle speed in Ring Spinning can increase the productivity and at the same time lower the quality. In practice, however, one would expect the opposite relationship for the simple fact that a mill having very low productivity would be invariably having below standard raw material, necessitating high tpi, badly maintained machines, etc. It is also not possible for a mill to attain very high productivity without at the same time having good quality. Studies conducted by SITRA[3] have confirmed that there is a positive correlation between production and quality.

In 1956, SITRA conducted (and published) a research survey of labour pro-

3 Sreenivasan, K., Shankaranarayana, K.S., Singh, Dr. Sitaram, Quality Production and Marketing of Yarn, SITRA Research Reports, Vol. 2, No. 7, November 1957.

ductivity in cotton spinning.[4] Here a comparison has been made in respect of mills, included in both the surveys. Chart V gives the per cent difference in productivity in the 31 mills. In 21 mills, an average increase of about 13 per cent has taken place, in four mills, no significant difference has been found in six mills, however, productivity has declined by about nine per cent. The average increase in productivity has been estimated at about 7 per cent and this could be attributed to :—

1. The Industry-wide Work-Load Agreement which came into force after the first survey.
2. Modernization and renovation that is being gradually effected.
3. Servicing schemes of SITRA in the form of quality control, productivity surveys, testing, work-study, etc.

As the main object of the present survey is to explore the possibilities of increasing productivity by making full utilization of the existing equipment and replacing obsolete techniques, the effect of higher work assignment or rationalization has not been taken into account. However, studies conducted by SITRA[5] have indicated a good scope of increasing work assignment at 75 per cent work-load.

If the present pace of progress is accelerated and the work assignment is also increased, productivity could be increased by more than 100 per cent.

4 Singh, Dr. Sitaram, Labour Productivity in Cotton Spinning, SITRA Research Reports, Vol. 1, No. 2, October 1956.

5 Ittyerah, G. and others, Work Assignment in Coimbatore Textile Mills, SITRA Research Reports, Vol. 4, No. 3, September 1959.

★ ★ ★ ★

TIME: THE PRODUCTIVITY COMPELLER

Choice of Technology in Industrial Planning*

JAN TINBERGEN†

CHOOSING the proper technology of production, which is one of the major problems involved in the establishment of a development plan for a national economy, has to date been dealt with either from a very general standpoint by planning authorities or on a purely *ad hoc* basis by practical administrators or engineering experts. The former have often paid relatively little attention to technological conditions and requirements of particular industries, the latter to the over-all economic policies of the country. Very often, neither planning authorities nor engineering experts have seemed to be aware that the problem of choice exists for a large number of industrial activities.

The problem, however, is of sufficient importance to justify a systematic approach. It arises in many industries when a decision must be made on the type of plant to be erected, which involves a choice of the type of industrial process, and the appropriate combination of machinery and labour.

Much emphasis has been laid on ways and means of increasing a country's resources in capital through domestic savings, capital imports, or both. Equal attention ought to be devoted to the most efficient and economic use of both capital and labour resources. The development of technology—so far largely influenced by the particular conditions of the industrially advanced countries of the West—has been characterized by the growth of capital-intensive, labour-saving processes, in line with the evolution in these countries of the relative prices of capital and labour, which has been favourable to such a development. There are now good reasons to reconsider realistically the technological problems involved in the industrial development of under-developed countries in the light of the endowment in factors which generally prevails in these areas. In many cases, the appropriate technologies would be much less capital-intensive than those in use in industrial countries, and would result in employment of more labour. The resulting savings in capital could be used in other development projects and contribute to further employment of labour.

The way in which the problem of choice of technology has been dealt with so far has not been very satisfactory. On the one hand, too much weight has frequently been given to the purely tech-

* Abridged from Industrialization and Productivity, Bulletin 1, United Nations, New York, April 1958.

† Mr. Jan Tinbergen, Professor of Econometrics at the Netherlands School of Economics at Rotterdam, and a former member of the Secretariat of the League of Nations, has served on expert committees of the United Nations, as an expert of the United Nations Technical Assistance Administration, as an adviser to the International Bank of Reconstruction and Development, and as a representative of the Netherlands at United Nations meetings.

nical considerations of the engineers, whose preferences are generally for the most up-to-date processes, regardless of the economic considerations involved. On the other hand, considerations of prestige have led, in many cases, to erection of overly ambitious plants, and installations out of proportion to the real needs and resources of the economy. Excessive mechanization has also at times been introduced in industry in under-developed countries in order to avoid "the trouble of dealing with people", that is, to avoid the occurrence of human errors, and to lessen the effects of labour turnover, burdensome and irksome labour legislation, strikes, and so on. When pushed too far, such practices have had consequences contrary to the basic interests of the national economies concerned. *The economic system should be run in the interest of all citizens;* if part of them are excluded from the production process, serious strains may occur in the longer run in the political and economic structure of the country.

It is sometimes contended that, in the so-called "development sector" of the economy (such as heavy industry), capital-intensive methods should be used in order to obtain a maximum rate of output, the "surplus" unskilled labour being employed in sectors allowing for labour-intensive techniques (for example, public works, such as construction of dams, roads and railways). Such an approach implies a somewhat arbitrary subdivision of the economy into sectors to which a different development policy is applied. It might be argued that a better use would be made of the countries' resources in both capital and labour if relatively more labour and less capital were used in the so-called "capital-intensive sectors" and relatively more capital in the "labour-intensive" ones. Theoretical considerations somewhat outside the scope of this article seem to support such a suggestion.

To be able to make a rational choice of technology, the authorities in charge of industrial development should be aware of the technical possibilities that are available; such information is at present extremely scarce. Before presenting a brief review of the present state of knowledge in this field and of some of the ways and means to improve such knowledge, some preliminary clarification of the underlying concepts may be useful.

In establishing a development plan, one has to face apart from the quantitative problems involved—a qualitative choice, namely (i) what goods to produce, now and in the future, and (ii) how to produce them. Both questions involve consideration of the relative quantities of labour and capital required for production or, to use the economic language, of the factor proportions to be used. Generally speaking, any given commodity or service can be produced in a number of ways, some of them more capital-intensive, others more labour-intensive, so that with a given composition of the national product, it is possible to vary the proportions of factors used. However, the composition of the national product itself need not be a given magnitude; it may also vary to some extent. Such variation may take place—apart from changes in exports—through changes in domestic demand influenced by variations in relative prices. It is such a variation in the structure of the national product and, consequently, in the proportion in which the factors labour and capital are to be demanded, that is the object of the choice under (i) above.

As to the choice under (ii), in discussing alternative technologies the structure of costs should be considered from the point of view of factor use. There are, on the one hand, labour costs, that is, wages and salaries, and on the other hand, capital costs, that is, all income paid out to capital owners,

namely interest and net rent. All costs of production can thus be reduced to the two factors labour and capital, the proportions of which will depend on the processes used in production. The analysis should therefore cover not only the last stage in the process of production of given goods, but the entire cumulative process of production, including all intermediary stages. For countries which import part of their requirements in raw materials, semi-finished products and capital goods, an additional element of cost is the value of imports which enter the production process. The cost schedules to be considered will thus relate theoretically to a certain number of possible alternative sets of cumulative production processes expressed, for each alternative, by the costs of labour, capital (including land) and imports.

Under each of these categories, costs are represented by the product of prices and quantities of the factors used. Since the prices of factors depend on the aggregated quantity demanded in the economy in relation to the available supply, the basic technological data concerning each industry are, in the last analysis, the relative quantities of the factors of production. The theoretical answer to the question of what technology to select is given by the relative prices of labour and capital in the country concerned. These prices measure the relative importance, for the country, of giving up one unit of labour and one unit of capital, respectively. Clearly, the replacement of a unit of capital by a unit of labour involves a larger real cost for a country where labour is the relatively scarce factor; the reverse is true for countries where capital is the relatively scarce factor. Thus, on the basis of these considerations the former countries will in general be well advised to use production combinations of higher capital intensity, while the latter countries will preferably make use of more labour intensive methods. The relative proportions in which capital and labour will be combined will depend on the relative prices of these factors.

Under certain circumstances, the relevant prices for the solution of this problem will not be the market prices of labour and capital, but what may be called "shadow" prices. This applies, for instance, if there is a surplus of a given factor (for example, labour) that cannot be used for lack of complementary resources (capital or land, for example, or management, if one considers the latter as an independent factor). In areas with heavy disguised unemployment, it may be appropriate to consider that the "real" price of labour is lower than the market wage rate, at least as far as government projects or subsidized private projects are concerned. In the same way, if scarce capital resources are being rationed (through import controls, selective credit policy or other means), the "real" price of capital should be taken as being higher than the market price. Due regard should be given also to possible future price movements during the lifetime of the investment which is being considered.

Leaving aside the technicalities which depend on the goals of economic policy in each country, the essence of *planning should be that all industries taken as a whole employ as nearly as possible the entire capital stock and the entire labour force. To leave part of these resources idle would result in a waste of resources and less than optimum level of production.*

Aside from considerations of over-all policy, the planner will also have to consider a certain number of secondary implications, some of which are of major importance from the point of view of planning individual projects.

The first is the scale of production. Generally speaking, the quantities of

labour and capital used per unit of output, and hence the method to be selected, are only in exceptional cases a simple linear function of (that is, directly proportional to) the quantity to be produced, which depends on the size of the market. In most cases, the relationship is more complex. Sometimes national income will be a decisive factor in the size of the market. In such a large and complex sector as that of the metal industries, it may be the degree of specialization and standardization which will be decisive. Density of population may be another important factor.

A second consideration, related to the first, is the appropriate size of plant. Some methods of production require large-scale plants in order to operate efficiently; other processes may be carried out efficiently in small plants. In the first case, the consequence will be concentration of industry in urban centres, with its economic and sociological implications in the form of migration of workers to cities, and need of provision of housing and other social facilities. Under certain circumstances, the resulting disadvantages may be of sufficient magnitude to affect the choice.

A third consideration concerns the flexibility of the process. As a rule, processes requiring little capital or capital goods of a short life expectancy can be more easily adjusted to changes in demand than processes requiring huge capital investments in fixed plant. The dynamic nature of the anticipated demand may thus be a factor in the final choice, which may differ from one based on considerations of a purely static nature.

A fourth consideration relates to the type of labour needed. Certain mechanized processes require highly skilled labour; others require relatively less skill. The choice of technology may thus depend upon the quality of the available labour force and the existence of, or possibilities of establishing, training facilities; such considerations may again affect the choice of technology.

A fifth consideration concerns the quality of the product. Application of processes involving different levels of mechanisation may result in differences in quality which may be tantamount to differences in product. Thus, in metal working industries where a high degree of precision is generally required, there may be a decisive reason for preferring capital-intensive processes. However, if differences in quality are acceptable and can be discounted by adequate price differences, an optimum solution along purely quantitative lines is possible.

Little research of a systematic nature has so far been carried out on the problems discussed in the preceding paragraphs. There is probably a wealth of material in cost studies made by individual enterprises for specific purposes, but few attempts have been made to collect and present it in a form appropriate for the purposes stated above. A search for such material for use in the present article has shown that some leading centres of research in industrial economics and industrial costs have failed so far to give systematic attention to this problem, and have found it difficult even to supply illustrative data.

Two main lines of attack suggest themselves and, in fact, are being applied in a few research institutions. The first is a "macro-economic" approach using available statistical data which have generally been collected for purposes other than those under discussion. Essentially, the data are averages for industries or groups of enterprises in different countries, for different time periods, different forms of industrial organisation, and other

differing characteristics. Comparisons have been made of the amount of capital per worker in the cotton industry in various countries, for various periods and, in a country like India, for mills and cottage type of production. The figures—some of which have been collected by the Division for Balanced International Growth, of the Netherlands Economic Institute—show, as a rule, marked differences between high-income and low-income countries. Similarly most historical series show a well-defined increase over time in capital per employee, for the same industry. The usefulness of such figures for planning purposes is, however, very restricted. At best they would give an indication of the orders of magnitude involved.

The other method, which appears to be the only promising one, is the "micro-economic" approach. This method consists in acquiring precise information, largely of a technological nature, on the alternative processes available, on an industry by industry basis. The relevant information will be collected for planning purposes or for narrowly related objectives and will be adapted entirely to these ends.

The following example illustrates this method. A report of the United States Department of Agriculture describes six methods of materials handling, designated respectively by A, B, C, D, E and F, and gives the labour and equipment costs corresponding to each technique.

Method	*Cost (in dollars) of loading one ton*	
	Labour	*Equipment*
A. Low-lift platform trucks and dead skids for assembling and belt conveyors for loading ..	1.74	0.44
B. Two-wheel hand trucks, semi-live skids and jacks for assembly, belt conveyors for loading	1.46	0.12
C. Semi-live skids and jacks for assembly and elevating and horizontal belt conveyors for loading	2.02	0.18
D. Fork-lift trucks and pallets for assembly, belt conveyors for loading	1.19	0.31
E. Four-wheel hand trucks, fork-lift trucks and pallets for assembly, gravity conveyors and manual handling for loading	2.13	0.14
F. Four-wheel hand trucks for both assembly and loading ..	1.41	0.02

Paradoxically, some of the methods require not only more capital but also more labour than others. Thus, methods A, B, C and E require both more labour and more capital than method F, while A also requires more of both than D. Clearly, the implication is that, at any price of labour and capital, A, B, C and E will be more expensive than F; and D will always be cheaper than A.

A similar micro-economic study on factor proportions with a view to exploring possibilities of capital saving has been undertaken recently by the Netherlands Economic Institute and the Training and Research Foundation. In the report, data are presented on two alternative methods of metal surfacing: by hand file and by electrically-driven, hand guided grinding tool. Cost functions were derived for the two methods with given wage and interest rates. Assuming constant costs per unit of output, both cost functions can be represented as straight lines with different gradients; the intersection point of the two lines gives the "break-even point," that is, the point of equal total costs for the two techniques. For given wages and interest rates this point depends on the volume of output, that is, the number of cubic centimetres filed off. With lower wage and higher interest rates,

the break-even point occurs at higher output. The labour-intensive technique is the cheapest for any output with wage rates equal to, or less than 0.14 guilder per hour; for wage rates above 0.50 guilder per hour, the break-even points occur at very low levels of output.

A second case study made by the same Institute concerns the manufacturing of certain machine parts by three alternative techniques involving use of three types of lathes: an engine lathe (I), a turret lathe (II) and an automatic lathe (III). The machine parts are three simple workpieces machined out of bar steel, and produced in fixed proportions to each other. With the help of time data and other data obtained in manufacturing the parts on lathes I, II and III, cost functions for each method were derived. A complication had to be introduced in this case—use of the maximum capacity concept. The least-cost combinations of lathes were determined for each level of output for two cases: A, a wage rate of 1.50 guilder per hour and an interest rate of 4 per cent per year; B, a wage rate of 0.05 guilder per hour and an interest rate of 15 per cent per year.

Two factors are particularly important for the economic choice of lathes: (i) the number of types of different machine parts; (ii) the desired number of machine parts of each type, per year (production run). With a small production run, a general-purpose lathe (lathe I) will be cheaper as compared with a special-purpose machine. With a large production run, special-purpose equipment (lathes II and III) will have lower production costs.

A third study has been conducted recently by the Netherlands Economic Institute in the wood industries. More than twenty-five factories manufacturing window frames, wooden parquet flooring and furniture were visited, and time data were collected. In these industries, the alternative techniques can be divided into three broad categories, according to the use of single-purpose, multi-purpose or special-purpose equipment. While the data obtained are still being analysed with a view to determining the factors influencing the choice of equipment, a preliminary conclusion may already be given: the production run is here also a predominant factor in determining this choice. In small-scale factories where short production runs prevail, use of multi-purpose equipment can lead to considerable saving in capital. This is particularly the case in the furniture industry, which is characterized all over the world by its small scale of operation.

Finally, a case study made by the Eastman Kodak company on costs in materials handling may be mentioned. The study gives figures on annual labour costs and required capital investment for three different methods of shipping the company's products, based on an analysis of cost data.

According to these and other figures given in the study, the combined use of tractor train and dragline conveyor is the cheapest method of operation under labour and capital cost conditions prevailing in the United States. This conclusion does not necessarily apply under conditions of lower wage or higher interest rates, or both.

Since it can hardly be expected that planning activities should wait until all the relevant material has been collected and analysed, it appears useful, even at this early stage, to summarize the evidence available. While the resulting picture is uncertain and incomplete, it may still be of some practical value for planning purposes.

The available evidence of macro-economic nature shows that the average

volume of capital per employee is consistently higher in industrial operations in the developed countries than in under-developed ones. This would strongly suggest that there are many industrial processes allowing for alternative methods of production of varying capital intensity. Yet technicians frequently appear to think that many processes present no flexibility whatever in that sense and recommend that methods involving the same capital intensity be applied in countries with very different factor endowments. In support of this contention, it is often pointed out that there is not much difference between processes applied in large-scale plants whether in countries with developed economies or in under-developed ones.

It is to be observed, however, that the operation of many industrial processes involves a certain number of subsidiary activities in addition to the production process proper, such as materials handling ("internal transportation"), packaging, shipping and administrative activities. Such operations can be undertaken by way of a wide variety of methods, ranging from very labour-intensive to highly capital-intensive. It is a common experience of those who have visited plants and offices in under-developed countries to discover that there are, in comparison with developed countries, much larger numbers of people engaged and not always continuously—in transporting materials, documents or messages. It is often this "surplus" manpower rather than labour engaged in production proper that accounts for the higher labour-product ratio observed there. As is well known, some of these activities, in particular materials handling and administrative operations, have undergone during the last decades a process of extensive mechanization in most industrial countries, though even there it has not been by any means a general development. Such changes were justified by the rise in wage levels, even though examples may be given where, on closer examination, mechanized devices did not appear to result in lower costs; this was so, in particular, where the scale of operations was not sufficiently large or the operations not sufficiently uniform.

There are a few other activities, not typically industrial, where large divergencies in capital intensity appear to prevail. Transportation, taking the term in its widest sense, is one of them. Between the use of head baskets by Chinese or Indian workers and use of heavy trucks, there is a wide range of intermediary methods and combinations of methods involving use of numerous types of light or of heavier vehicles, moved by hand or drawn by animals, or by mechanical power. Even a railway system may be operated in widely different ways, as is shown by a statistical comparison of the operation of American and Indian railways. Here again, it is probably in the auxiliary operations such as loading and unloading, passenger service and administration, that the greatest variations in capital intensity can be found.

Another area of widely varying alternative production processes is to be found in the complex activities related to construction, including house, office and factory building as well as construction of roads and dams. Especially where moving of large volumes of earth is involved the methods used vary from extremely labour-intensive to extremely capital-intensive.

There seem to be, however, possibilities of applying methods of varying capital intensity also in manufacturing industries, where highly mechanized processes are the usual practice. The textile industry is a well-known example in this respect. Foundry work is another field where a study of alternative

techniques would appear to yield interesting results.

For purposes of general planning, it is of interest to ascertain whether a set of general principles which would be of relevance to the problem of choice of technology could be derived. Such principles might also provide some guidance for developing new trends in the design of machinery so as to lead to possible savings in capital resources. One principle which is of interest for the latter purpose seems to have been brought out clearly in the study by David Granick of the machine tool industry in the Union of Soviet Socialist Republics, namely the principle of specialization. Specialization generally leads, particularly in metal-working, to an increase in idle capacity of machine tools, since even the best planning may not always bring about capacity operation. In countries with short labour supply and high wages, it is the workers' time that should be continuously occupied, whereas in countries with capital scarcity it is equipment that should be utilized to the utmost. Thus, use of specialized machinery will be more indicated in the former countries, while use of multi-purpose tools would be preferable in the latter.

Among other general principles of this type which may provide guidance to planning authorities, one relates to the question of optimum speed of operation. High-speed machinery is usually relatively more expensive to acquire and to operate (for instance because of high consumption of fuel and oil) per unit of product. In low wages and high capital cost countries, it may be preferable to operate at lower speeds—this independently of whether workers in these countries are sufficiently trained to operate highspeed machines.

Another tentative principle is that more attention should be given to repair. On the one hand, repair is a labour-intensive activity; on the other hand, it is a capital-saving operation. It is a well-known fact that, in the group of developed countries, repair as a significant industrial activity is concentrated in countries with relatively low wages. There is, for instance, a well-developed industry in the Netherlands engaged in repairing British, Scandinavian and United States ships.

The subject discussed here is important enough to warrant further research. As already mentioned, research based on a macro-economic approach does not seem promising and, therefore, future research will have to be concentrated on specific industry studies and in particular on existing methods of production. This is an extremely broad field, and the question arises as to how best to use the available resources. There are a great number of elementary processes to be studied, and a systematic analysis of all of them would be an overwhelming task. To cope with it, it would be necessary first of all to evolve certain general principles to guide further research in a systematic way. It would thus seem useful to start with a few random explorations from which some inductive generalizations might be derived. Some general principles have already been formulated, mainly those relating to specialization and speed of operation, discussed above.

The method of research may be formulated as follows: The available alternative methods for producing a number of well-defined goods are to be described in terms of the required quantities of labour and capital. It will then be attempted, by appropriate grouping according to certain principles, to elicit the underlying factors which determine possibilities of substitution.

The description of the processes should satisfy a number of require-

ments. In addition to location and time of observation, the data should cover, among other things: (i) the nature of the product, including quality; (ii) output per unit of time; (iii) types and amounts of labour involved; (iv) quantity of capital used, including method of valuation; this should be given, if possible, by type of equipment; (v) depreciation allowances; and (vi) other input. Data should be collected for different levels of output in order to estimate fixed and proportional costs.

Promising sources of information are likely to be those agencies and enterprises which, by nature of their operations, have collected comparable data on a variety of processes. Individual enterprises often have to engage in comparative studies of different methods of production before making a choice. It is to be expected, however, that in a number of cases choices are based on superficial considerations, so that material of this kind may not always be relevant; enterprises may also hesitate to give out information, unless it refers to outdated case histories.

A more promising source may be enterprises which have many foreign subsidiaries or enterprises working with a large number of small subcontracting independent firms. Several of the large concerns in the field of electrical engineering may have such information available; a number of them have special units dealing with subcontracting plants and are equipped to test, compare and improve the methods of production used.

Consulting firms in the engineering and accounting fields comprise another source to be explored. Their activities bring them in close contact with industry and involve investigation of cost and production data; their advice is also in many cases based on comparisons of alternative techniques of production. Critical examination of production processes in industry is also frequently made in the numerous tariff investigations of the United States Tariff Commission and similar agencies elsewhere.

In addition to the description and analysis of exising production processes, another line of research might be followed. As already observed, technical development has so far been largely inspired by the needs of the industrially developed countries and, as is well known, has been, on the whole, "neutral" as regards aggregate capital intensity: the effect of labour-saving devices developed in response to rising costs of labour has been offset by the development of new products and services, partly as a consequence of higher standards of living. The huge capital needs implied in the industrialization of underdeveloped countries should provide an incentive for technicians, industrialists and governments in these countries to reorient technological research with a view to meeting the requirements of their economies and in particular their need for saving capital.

Economy does not consist in saving coal, but in using the time whilst it burns.

Ralph Waldo Emerson

EXPERIMENTS IN PRODUCTIVITY

(NPC Announcement 1)

On page 18 of this Journal, an article appears on Experiments in Productivity, indicating substantial achievements accomplished through Methods Study in a major aluminium concern in this country. It is proposed to publish such Case Studies, as may become available, in the pages of this Journal. The National Productivity Council hereby invites industrialists, management consultants and others interested to furnish information to NPC regarding successful introduction of productivity techniques in the fields of industrial management, engineering, labour relations, methods study, incentive schemes, quality control, materials handling, plant layout and the like. Our Regional Directorates at Calcutta, Kanpur, Bombay, Bangalore and Madras are in a position to advise regarding the manner in which these case studies may be presented. Broadly the procedure is that conditions obtaining prior to the introduction of productivity techniques are detailed with a view to highlight the productivity increases achieved through methods study. It is optional for persons and institutions, submitting such case studies, to decide whether NPC may publish them in this Journal or otherwise. The use to which such information will be put will depend entirely upon the wishes of concerned parties. The idea is to set in motion a sort of cumulative chain of causation by which knowledge of productivity techniques at one place leads to general advances in productivity by which the whole community benefits.

Technical Digest

(NPC Announcement 2)

The National Productivity Council has received a lot of excellent technical material on subjects detailed below, which it would like to share with editors of technical and industrial journals. Mostly it is material from publications giving an account of outstanding American and European technological and industrial developments. It is mostly of a copyright nature but the National Productivity Council has arranged that it could be published *once* in India. The select material is at the moment available on technical developments in the following lines: Ceramics; Chemicals Equipment and Supplies; Electric Equipment and Supplies; Food and Food Products; General Industrial; Heating, Piping, Air-Conditioning and Refrigeration; Lumber and Wood Products; Management; Materials Handling; Paper and Paper Products; Plastics; Rubber and Rubber Products; Structural Engineering; Transportation etc.

Printed and published by Sri D H Butani for the National Productivity Council, 38 Golf Links, New Delhi, at The National Printing Works (The Times of India Press), 10 Daryaganj, Delhi.

RN 4757/59

ABOUT THIS JOURNAL

"The first number of this new bi-monthly journal devoted to productivity problems is very well produced and printed. It contains excellent articles on standardisation, worker-management co-operation, quality control, health and productivity, large and small enterprises in Japan etc. Every contribution is worth reading....."

The Hindu, Madras, November 8, 1959.

".....I have just finished a study of the Journal and hasten to tell you that what you have brought out is an excellent publication even by European standards....."

S T Merani,
Indian Delegation to International Organisations,
2, Place DES EAUX—VIVES
GENEVA.

"The get up of the Journal and the selection of articles for the first number are of a very high standard. Its value is definitely enhanced by the various well selected cartoons dispersed throughout the Journal."

M S Katre,
TISCO, Jamshedpur.

"We have every reason to believe that this Journal (Productivity) will go a long way to promote National Productivity by enlightening and enthusing all concerned with the object."

Science and Engineering,
Calcutta.

"This is an excellent publication....."

Commercial Division,
High Commissioner for Canada,
New Delhi.

Editor: D H BUTANI