PRODUCTIVITY

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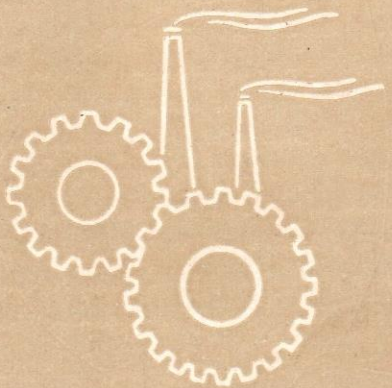

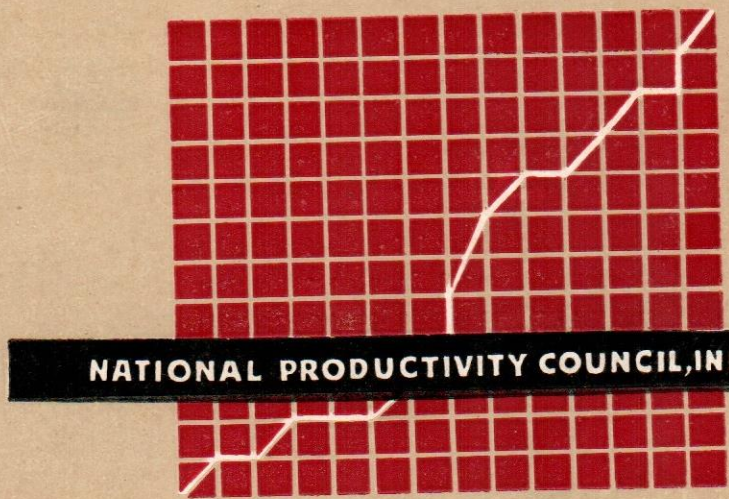

NATIONAL PRODUCTIVITY COUNCIL, INDIA

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!

Opinions expressed in signed articles are those of the authors and do not necessarily reflect the views of NPC.

Page

"...While we think of the targets of investment and production, we should also think of human character without which we cannot even dream of success for our Plans ...We often hear that such and such a thing has failed. The machine was all right, the equipment was all right, everything that could be done was done all right, yet it failed because of human failure. What we should do is to attach the same importance to the human side that we attach to the material side of things ...

Looking at the country's economic problems one is struck by wastage all round. If this could be stopped, there would be tremendous progress...."

Rajendra Prasad

"...India would not be able to achieve all round progress unless she built up the proper industrial base by adopting recent developments in the fields of science and technology ...

I request you to forget all differences and think of nothing but crossing the river and reaching the other shore...."

Jawaharlal Nehru

"... we must be strong in the source of all our armament—our productivity ..."

Dwight D. Eisenhower

Trends in Industrial Productivity

BY its Charter, NPC is charged with the function of creating conditions favourable to the evolution and application of productivity techniques in the field of industry. NPC of course is only two years old but in course of time the evaluation of NPC work will itself necessitate the measurement of industrial productivity and a critical analysis of its constituent factors. Also because of the peculiar nature of its function, the NPC and those associated with it are frequently asked questions as to the trends in industrial productivity. Otherwise too, there is a paramount public interest in the subject as determining the level at which the people will live and work; also in view of the scarcity of resources, in physical and organisational terms. By next year we shall have completed a whole decade of economic planning; hence an answer as to the trend in industrial productivity will be called for.

Living, as we do, in an atmosphere of public criticism, the question itself as to the trend in industrial productivity conceals a suspicion that either in the economy as a whole or in certain of its important sections, productivity has gone down. While a complete answer will naturally depend upon the availability and refinement of a large mass of statistical data, some sort of a clear answer can surely be hazarded on the basis of available statistics: that with all the limitations under which the Indian economy works, there has been, very obviously, a massive increase in industrial productivity.

This answer need not await any detailed analysis of the concept and measurement of productivity on which, however, we propose to publish a series of articles in the coming issues of the Journal. Philosophical and conceptual clarity is essential in this field, as elsewhere, but it will come only as a result of decades of continuous intellectual fermentation. In the meanwhile, the country calls for what it badly needs—the maximum utilisation of its resources with a view to guarantee the security of the country and some sizeable improvement in the standards of living. There are very obvious facts to show that a move in the direction is taking place.

Even without waiting for refined, detailed statistics, it is easy to make out a *prima facie* case for a substantial increase in industrial productivity. The very fact that per capita consumer expenditure at constant (1952-53) prices increased by 9 per cent during the First Plan period, despite a large increase of population during the period, is a broad index of the higher productivity of the economic system. Simultaneously, we were able to increase investment from 4.9% in 1950-51 to 7.3% in 1955-56. Taking the whole decade, covered by the two Five Year Plans, 1950-51 to 1960-61, the following statistics of national income, investment, savings

and consumption are a sure index of substantial increases in productivity. It has to be remembered that all these monetary figures are at constant prices, so that they reflect real increase in productivity.

	Figures in million rupees at 1952-53 prices		
	1950-51	1955-56	1960-61
National Income	91,100	108,000	134,800
Net Investment	4,480	7,900	14,400
Net inflow of foreign resources	—70	+340	+1,300
Net domestic savings	4,550	7,560	13,100
Consumption expenditure	86,550	100,440	121,700
Investment as percentage of national income ..	4.5	7.3	10.6
Domestic savings as percentage of national income	5.0	7.0	9.7

It is true that these statistics are in the nature of estimates but they do decisively reflect the order of magnitudes involved, and since massive increases in industrial output have taken place in this period, they again do decisively reflect the upward tempo of the industrial system.

Popularly, industrial productivity is thought of in terms of population, employment and output. Even taking it this way, an increase in industrial productivity is an easily provable proposition. At the time of writing, our population is around 405 million. The census record for 1951 is 357 million; that is to say, an increase of around 13% has taken place in population between 1951 and 1960. In about the same period, the level of industrial output has gone up 53%, taking the latest available index of industrial production (1951=100) for July 1959. In about the same period employment in registered factories has gone up from 2.5 to around 3.4 million, that is, an increase of 36%. Against the background of these statistics, the proposition that there has been any decline in industrial productivity can be just ruled out of court. It can, of course, be a matter of argument as to how far the 50% increase in industrial output in the last decade is accountable by increased employment, higher labour efficiency, increase in industrial investment, and above all the adoption of productivity techniques.

In many significant sections of the industrial structure, the increases in output are in fact so large as to alter very significantly the whole scale of the economy. While employment in the coal industry has gone up by just 10,000 between December 1951 to July 1959—an increase of only 3 per cent—coal production has gone up from 34 million in 1951 to a current rate of annual output of around 45 million tons—an increase of 32%. This is, of course, a very crude measure of industrial productivity,

but not even the most refined statistical methods would take away from the substance of the increase. Corresponding, if not larger increases, have taken place practically throughout the whole of the mining industry, which is the basis of the new industrial development.

In cotton textiles—another major industry of this country—while employment since 1951 has gone up by some 55,000 or less than 8%, output has risen by nearly 12%; and it has been for a variety of reasons, one of our depressed industries in the post-war period. What probably is more significant is that in both these major industries—coal mining and cotton textiles—not much investment has taken place, except probably in the public sector of the coal industry in recent years.

Hence, it would be a valid generalisation (except for new industries) to take the output increases as broadly, though not statistically, indicative of the increases in productivity that have taken place during the period. The following table gives the statistical increase in output from 1951 to the latest available period, that is round about the third quarter of last year:

Percentage increase in output

1951 to August 1959 or thereabout

Coal mining	31.2	Sheet Glass	579.6
Iron ore	89.8	Cement	103.8
Sugar	75.5 (1958)	Ceramics	151.3
Tea	107.3	Iron and Steel	68.5
Tobacco manufactures	43.1	Non-ferrous metals	120.0
Cotton textiles	11.5	Screws	1098.3
Jute textiles	24.2	Razor blades	2009.9
Leather footwear	45.7	Diesel engines	255.6 (1958)
Rubber manufactures	106.8	Power-driven pumps	91.2
Sulphuric acid	135.7	Sewing machines	530.5
Caustic soda	351.2	Machine tools	694.8 (1958)
Chlorine liquid	359.9	Electric motors	323.5
Superphosphates	254.0	Radio receivers	158.6
Ammonium sulphate	651.4	Automobiles	90.0
Matches	30.3	Bicycles	788.1
Soap	58.1	Electricity generated	154.4
Rayon	684.7		

The last item, namely, the generation of electricity brings us to the most signficant point in this analysis regarding industrial productivity. It is a well-known axiom that power is the basis of the modern economy. Reference has already been made to the increase in output of coal from 34 to 45 million tons during the decade that is about to end. In electric power, our installed capacity in million KWs was 1.4 million at the time of Independence. It rose to 1.8 million at the beginning of the first Plan, 3.4 million at the end of the Plan and is likely to rise to 7 million KWs by the end of the Second Plan, that is the beginning of next year. Comparing, therefore, our economic position as at the beginning of Independence to what it is now or is going to be within a year, *our productive capacity in terms of electric power has risen five times.* In the beginning of Soviet economic development, socialism was equated with electricity, for it was then thought that the productivity of the economy was dependent upon electric power and the realisation of a socialist state would be frustrated without a substantial increase in industrial productivity. Hence the theory.

Increase in the installed capacity of electric power brings us to the crucial question of investment. Investment statistics are either not comprehensively available or are not statistically very reliable. It has been said that a very large part of the investment during the First Five Year Plan was not so much in additional plant capacity as in the holding of stocks. In the Second Five Year Plan, there has been in all probability a large investment in plant capacity, both in the private and the public sectors, as evidenced from the statistics of imports of machinery and of heavy goods. Substantial increases have particularly taken place in the public sector enterprises, of which investment in steel has been the largest.

Such increases in investment enlarge very significantly the productive capacity of the entire economy. In fact, that is the whole theory of public investment, particularly in steel, electric power and transport—what is known as the *infra structure* of the economy.

The increase in investment, however, is not only confined to the public sector. Statistics of installed capacity show that private *entrepreneurs* have effected substantial increases in investment in many lines. The table on page 5 is only illustrative of the large expansion that has taken place in many lines of industrial activity. As these installed capacities are in most cases in excess — in some cases, far in excess of current levels of output — it would be possible to *increase output without further investment.*

Investment, however, is not the only material factor. More essential in the Indian context is that the people in charge of affairs in this country should grasp the Fundamentals of Productivity. In this connection we would like to draw attention to the article that follows, coming as it does from an economist of international repute. It is worthwhile summarising here the main points in Dr. Lokanathan's thesis: ".....no social system can work without the willing cooperation of the working-class.....the most powerful techniques are those which in the first instance grip the minds and hearts of the men and women who work the industrial system. On the other

INSTALLED CAPACITY

In terms of monthly average output

(*a*) *Figures rounded to thousand*

(*b*) *Tons, unless otherwise mentioned*

	1951	Latest available (August 1959 or thereabout)	*Percentage increase*
Vegetable oil products (Vanaspati)	27	37	37
Western type footwear (pairs)	394	557	41
Plywood (million sq. ft.)	13	20	54
Paper	11	27	145
Sulphuric acid	17	30	76
Soda ash	5	9	80
Superphosphates	15	28	87
Matches (cases)	59	74	25
Soap	16	21	31
Sheet Glass (million sq. ft.)	2	9	350
Cement	296	659	123
Machine Screws	28	135	482
Electric motors (horse power)	13	28	115
Electric lamps (million)	2	4	100
Domestic refrigerators (number)	300	633	111
Complete cycles	10	88	780
Railway Wagons (number)	1413 (1955)	1688	19
Power alcohol (bulk gallons)	826	1266	53

hand.....no system — economic or political — can possibly work without responsibility being centred in some person or body of persons who must on pain of punishment deliver the goods.....a more productive orientation of the economy requires a positive and, of course, an egalitarian philosophy.....productivity or any other social end cannot be achieved by legal means.....no Code of Efficiency or Discipline or Welfare will work, unless the people involved mean business.....it is the general adoption of productivity techniques in the small affairs of life — and not courts of law — that can bring us the full fruits of the Constitution.....we shall succeed in our productivity drive only to the extent that we make life tolerable, if not comfortable, for the small man....."

This thesis has been carried forward by Sri B N Datar in an another article in this issue on Labour-Management Cooperation. Sri Datar refers to the revolution not only in the technological aspects of industry but also in the sphere of human relations. His conclusion is significant: "...it is a mistake to assume that the productivity method calls only for increased capital investment by the employer or greater efforts on the part of the worker. In fact it aims at increasing efficiency through a number of ways such as checking wastage, avoiding fatigue and monotony and in the process, securing greater job satisfaction." He calls for a policy which would provide "reasonable opportunities for worker participation in management thus ensuring that the interests of both employers and workers are merged with the interests of the undertaking itself and of the community".

To ignore, however, the technical aspects of modern industrial development would be to play Hamlet without the Prince of Denmark. To emphasise this aspect of industrial productivity, Professor R F Bruckart of TCM has at our request written a piece of expertise on How to Introduce an Industrial Engineering Department in Manufacturing Concerns, with particular reference to the conditions that obtain in this country. At a more technical level, we have given an exhaustive article on Time and Motion Study, prepared by the Methods Study Department of Hindustan Lever to which we are greatly obliged. Our industrialists would greatly benefit by a study of this character. At the end of this Journal, an NPC expert has generalised on the basis of his personal experience and training, as to how to make an industrial office a model of productivity in the modern economic sense.

As shown earlier, this country has achieved a good deal by way of enhanced industrial productivity in the historic decade that is about to end. The Third Five Year Plan, now in process of gestation, can push forward this trend in Industrial Productivity, if we are able to rationalise our thinking and *"action accordingly."*

Fundamentals of Productivity

P S LOKANATHAN*

THE Editor of Publications of NPC has for the past several months pressed on me, as Chairman of the Governing Body of NPC, to state the official position, somewhat authoritatively, regarding the Fundamentals of Productivity, so that the Productivity Movement could be rapidly canalised along right lines. I do not know, if an official statement of Categorical Imperatives would be of much use, for the Productivity Movement has to find its own bearings, largely through the autonomous working of social forces, aided by the devotion and technical competence of the productivity experts, both within and *outside the NPC.* I particularly want to emphasize "the outside," for it cannot be called a national movement, unless the NPC is able to carry along with itself the vast body of industrialists, managers and workers — carry them forward, as in a current, in which they enjoy the going forward.

On one thing, I can be absolutely unequivocal, both officially as Chairman, and also as an humble social scientist, who has for several decades watched the development of social forces, with concern and interest. There is no question of ideology involved, but it is a fact, which has to be accepted, whether we like it or not, that *no social system can work without the willing co-operation of the working class.*

For the Productivity Movement, this is a Must. The most powerful productivity techniques are those which in the first instance grip the minds and hearts of men and women who work the industrial system.

On the other hand, I do not know, nor can I conceive of any system, ranging from the purest *laissez faire* to communism of the reddest red, in which management can divest itself of the right of decision-making. No system, economic or political, can possibly work without responsibility being centred in some person or body of persons who must on pain of punishment deliver the goods. That, in fact, is true, not only with regard to private enterprise, but is equally applicable to the public sector. The totalitarian systems in communist countries apply the principle, in fact, somewhat more rigorously. Both Government and Labour must therefore unreservedly accept the right of Management to take decisions. That, of course, goes alongside the Management, bearing all the consequences of decision-making. In fact, what we need is a change in the basic social philosophy and the whole complex of attitudes that go along with it. What is really needed is a system, based on mutuality of rights and obligations, of responsibility in proportion to authority, exercised in an atmosphere of general friendliness. Unless for at least a decade or so, the people of this country, of whatever class or caste — be they top industrialists, chief ministers, janitors or Jacks — act and feel as *comrades in a common task,* no amount of mere economic planning will save a situation, which by all standards of judgment is full of poten-

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It is a concern not merely a question of

tialities for evil. Potentialities are, however, potentialities, which we have the will to shape, unless we are victims of Marxian or some other form of determinism. A more productive orientation of the economy requires a positive, and, of course, an egalitarian philosophy.

In fact, the Fundamentals of Productivity are embedded in our Constitution itself — a document which will play in the economic resurgence of Asia, a part, as historically important as that of the American Declaration of Independence. I ~~am not refering to~~ the Fundamental Rights, which are enforceable in courts of law. *Productivity or any other social end cannot be achieved by legal means.* No Code of Efficiency or Discipline or Welfare will work, unless the people involved *mean business.* Productivity cannot be achieved without a business-like attitude to the tasks of life.

A business-like attitude does not exclude the humanities. It does not negate a generous attitude to life. It is the universal experience of all bosses that the most generous of them get the most generous response from the men, associated with them. A business-like attitude is not born of sadism, authoritarianism and the like. It is born out of a conviction that the most effective humanism must be broad-based on the facts of life.

Even the Constitution ~~to which I have~~ referred, makes several good things for labour, conditional on the productivity of the economy, which in fact is specifically stated as the limiting factor to the achievement of these good things. Article 41 of the Directive Principles of State Policy reads as under: "The State shall, *within the limits of its economic capacity and development,* make effective provision for securing the right to work, to education and to public assistance in cases of unemployment, old age, sickness and disablement." Even the relief of "undeserved want" is made conditional on "economic capacity and development." It is the realisation of this truth—and not the idealism of the Left or the Right—that will help in the shaping of rational social policies.

It is precisely because of this that the founders of our Constitution made these Directive Principles of State Policy, *non-justiciable;* for it is the general adoption of productivity techniques in the small affairs of life—and no court of law—that can bring us the full fruits of the Constitution.

Yet it must be said that these Directive Principles constitute the essential framework of social policy within which alone a really productive economy becomes a practical proposition.

The Constitution directs the State to adopt policies with a view to secure the following ends: "that the citizens... have the right to an adequate means of livelihood ... that the operation of the economic system does not result in the concentration of wealth and means of production to the common detriment ...The State shall make provision for securing just and humane conditions of work and for material relief....The State shall endeavour by suitable legislation or economic organisation or in any other way, *to all workers,* agricultural, industrial or otherwise, *work, a living wage, conditions of work ensuring a decent standard of life and full enjoyment of leisure, and social and cultural opportunities....*"[1]

We have so far been discussing Fundamentals — the Fundamentals of Productivity. The most important Fundamental, however, lies in doing a multitude of small things, with grace and dignity. It was Alfred Marshall, the great economist, who said that he considered British Factory Legislation as a disgrace to British industry; for in his

1 Italics mine.

opinion the employers themselves should have come forward to give their workers the small things that the law had to enforce. It is a historical fact that the very elementary precautions for ensuring safety of human life in mines and factories had to be enforced by law. India has just embarked on the road to economic development and social reconstruction. If we have also to enforce by law the many small things that human beings require for fairly tolerable standards of working and living — such as comfortable sitting and lighting arrangements, medical and housing facilities and the like—the sheer enforcement of such regulations over an area of continental size and a population of ~~over~~ 400 million — the very making and enforcement of regulations will mean an *unproductive wastage of resources.* The really major failure in the productivity drive has to be looked for in the doing of small things — the observance of small courtesies which give men a feeling that they are men. The big things — the big plants, the know-how of big machines— will come as a matter of course, at the rate that we can absorb them; but we shall succeed in our productivity drive only to the extent that *we make life tolerable, if not comfortable, for the small man.*

~~Another Fundamental to which I attach importance is based on the principle~~ that a *community or an individual can grow only from within.* We have for too long looked out, a bit too much, to foreign sources of inspiration and aid. *These are necessary — but marginally.* A community or an individual who comes to live mainly on external assistance, is only beginning its or his process of decadence. *Productivity is life; it is not decay.* That is why, as Chairman of NPC, I attach a lot more importance to in-country teams than to the six-week foreign tours of men, who have to hurry from point to point with little chance of gathering knowledge. On the other hand, workers, managers, small industrialists going from plant to plant within the country, are in a position to absorb the developing productivity techniques. The whole social *milieu* is one which is intimate to the people who go round. Of course, it is much cheaper per unit of touring programme but we have to pay for it. It does not come free from abroad. In an ultimate sense, everything has to be paid for by the individuals or communities benefiting from it. The sooner we cease to believe in free gifts, the better would it be for the social growth of India.

~~The last~~ Fundamental that ~~I would~~ like to emphasise is research. Thinking closely and deeply, any social analyst would come to the conclusion that the basis of the tremendous technological advance of the West, including the Soviet Union, is research. If the resources that are at present going into politics and publicity were even to be fractionally devoted to research, the growth rate of the social economy would multiply infinitely. The productivity movement in India must switch on rapidly, for reasons of sheer survival, to research in the economic and technological aspects of productivity. In fact, research alone will enable us to deliver the goods; otherwise we shall have, due to undue publicity, created a demand for productivity techniques without being in a position to meet the demand. That really is the position as it has emerged as a result of the efforts we have made in the NPC for the last two years, since its inception.

And this research must begin in a spirit of humility. Productivity experts need to go out into the field and work on the spot among the workers, the managers, and small industrialists, to know what their problems are, to study their good points and their limitations, and to evolve workable techniques that would transform the industrial environment at its most critical points.

Labour-Management Co-operation

B N DATAR*

SINCE the turn of the century, the industrial scene has gone through a complete change. The revolution in industry, however, extends not only to the technological aspects but also to the sphere of human relations. There was a time when the employer tended to treat the worker almost on par with the raw materials used in the industrial process. Today, however, significant changes have been recorded in the status of the worker. Labour is no longer considered a mere inanimate commodity but is given the rights and responsibilities of a human individual. The community now accepts the employer and the worker as partners in production. The credit for securing this change in attitude must be shared between the pioneering efforts of progressive employers and enlightened trade unionists, on the one hand, and the official policies of Government directed towards securing the well-being of the worker, on the other.

But in spite of these basic changes in the aspects of technology and human relations, the objectives of industry continue to be exactly the same. Industry is organised to produce the maximum output. Industrial unrest tends to affect this production. Thus it is evident that human problems have come to be woven into the overall process of production.

There are two recognised ways of increasing production: one consists of investing more resources in production, the other of producing more from the same amount of resources. The latter has been described as the productivity method and it assumes special significance in the context of strictly limited resources.

It is a mistake to assume that the productivity method calls only for increased capital investment by the employer or greater efforts on the part of the worker. In effect, it aims at increasing efficiency through a number of ways, such as checking wastage, avoiding fatigue and monotony and, in the process, securing greater job satisfaction.

The need for increasing productivity cannot be overemphasized in the context of the highly competitive character of international markets. What is true of the international market is equally true in the case of the domestic market. An increase in productivity would make available to the consumer a larger number of better quality goods at lower prices. At the same time, this would result in increasing industrial employment and the worker would get the benefit of higher wages and better working and living conditions.

Thus, it will be seen that productivity can be secured through efficient organisation and use of existing resources and the application of improved techniques. But if these efforts are to succeed, it is vital that they receive the whole-hearted cooperation of all persons engaged in industry, including

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the workers and their representative trade unions.

Offer of higher wages usually serves to encourage labour to greater efforts, but only up to a point. The urge to improve one's performance must essentially come from within and must take into account such factors as enthusiasm, initiative and a sense of loyalty. In fact, a productivity drive is primarily directed towards developing the willing cooperation of management and labour in a common enterprise.

But gaining the confidence of the worker is no easy task. This can only be done if the worker is given his rightful place in industry. Industry is a joint endeavour and the various parties who contribute to its functioning can be described as partners. The employer organises and plans. The worker contributes his labour and skill in the execution of these plans. The consumer is the unseen but ultimate partner in industry. The partnership principle can take many forms. In essence it is a sincere recognition of the rights and responsibilities of the concerned parties and it provides for the widest possible consultation between employers and workers and, in some cases, of consumers, as well. These principles have come to be generally accepted.

It has often been asked as to whether there is any real basis for labour-management cooperation. The answer is very definitely, yes. Both workers and employers are interested in securing greater production; they only differ in the matter of sharing the product. Both parties have increasingly begun to realise that they can only share as much as they produce. Therefore, it is in their own interest to increase the total size of the cake. As to the question of sharing, the interests of labour and management can never be expected to be completely identical. They can, however, develop certain healthy and cooperative attitudes in arriving at a mutually acceptable solution. What is needed most of all from both parties is the willingness to cooperate in achieving mutual goals.

Most conflicts can be resolved if the employer and the worker can arrive at a basis for mutual understanding. It seems an anachronism for any progressive employer to continue to assert that the interests of the workers are safe in his hands. It would be more realistic to agree to the workers setting up their own unions and even to assisting these unions in securing a sound and representative basis. Similarly, in accepting the principle of seniority, management can ensure that the criteria of merit and efficiency are not totally ignored. In recent years, management and labour have displayed considerable ability in resolving the problems of un-employment that arise out of technological improvements in industry.

It is possible to list a number of goals of labour and management which seem incompatible but, in reality, serve mutual interests. For example, while the worker is eager to improve his status in industry, the management are keen on securing the economic interests of the industrial undertaking. It is necessary, however, for labour and management to accept the separate functions that they have to perform. It is the function of the trade union to secure the interests of the worker in terms of improvements in wages, hours of work, working and living conditions. For both these objectives, industrial peace is necessary; hence the need for labour-management cooperation.

Labour-management cooperation is not an entirely new concept. It has been initiated in a number of countries and implemented under different forms. These variations can be traced back to differences in economic, technical, so-

cial, historical and psychological conditions. In some countries, the basis for cooperation is completely voluntary; in other countries, the right of workers to participate in management has been established by law. In some industrial units, the worker has only the right to advise; in others, he participates in decision-making on certain items of work. The differences extend to the structure and composition of the machinery of labour-management cooperation, the range of subjects handled and the degree of participation. The underlying motive for cooperation, however, is the same, viz., to raise productivity for the benefit of all. The various efforts at cooperation have met with different degrees of success, depending upon a number of factors, including the prevailing climate of industrial relations.

Joint consultation cannot be considered a new concept in India. Mahatma Gandhi gave a new angle to the concept of partnership in industry. For him, employers and workers were members of the same family. He considered that the rich should treat their wealth as held in trust for the community. Extending the doctrine of trusteeship to industry, employers and workers are required to organize and run industry for the benefit of the community.

It was in the context of a socialist society and the urgency for fulfilling the development targets that the Planning Commission reiterated the need for securing greater association of workers in management. In this regard the Industrial Policy Resolution (April 1955) stated: "In a socialist democracy, labour is a partner in the common task of development and should participate in it with enthusiasm. Some laws governing industrial relations have been enacted and a broad common approach has developed with the growing recognition of the obligations of both management and labour. There should be joint consultation, and workers and technicians should, wherever possible, be associated progressively in management."

Continuing this trend, Planning Commission in its report on the Second Five Year Plan recommended the setting up of Councils of Management in large industrial establishments with representatives of management, technicians and workers. Government also sent an expert group to make a first-hand study of European experience in this field. The Study Group recommended the setting up of Joint Councils, and, in accepting their recommendations, the Indian Labour Conference (July 1957) considered that the experiment should be initiated in 50 industrial units drawn on a voluntary basis from the public and private sectors.

Early in 1958, a tripartite seminar on labour-management co-operation was organized by Government. Among those attending the seminar were workers and employers drawn from units that had agreed to set up Joint Councils. The seminar chalked out the constitution and functions of Joint Management Councils and drafted a model labour-management agreement for setting up such Joint Councils. The model agreement provides that the Joint Councils should endeavour: (i) to improve the working and living conditions of employees; (ii) to improve productivity; (iii) to encourage suggestions from employees; (iv) to assist in the administration of laws and agreements; (v) to serve generally as an authentic channel of communication between management and employees; and (vi) to create in the employees a live sense of participation.

The Councils are to be vested with varying degrees of powers and responsibilities. Broadly speaking, they will be responsible for all subjects which exclusively affect the worker; they will be consulted by management on subjects such as the administration of

standing orders and the introduction of new production techniques and also will receive information on the organization and running of the undertaking and make suggestions for improvement.

Since the organization of the seminar, a number of units in the public and private sectors have set up machinery for joint consultation. While most of the units have followed the model suggested at the seminar, others have followed their own patterns. In some units, the statutory works committees have been reorganized and given the wider functions of the Joint Councils. In other units, the existing machinery for joint consultation has been made more broad based. In the private sector, the experiment is being tried out in units of the jute, textiles, tea, cement, iron and steel industries. The machinery employed is the Joint Council of Management working through sub-committees for subjects such as productivity, waste, stores consumption, welfare and safety. In other cases, instead of a single Joint Council there are separate Joint Committees for aspects such as job evaluation, standards and personnel relations.

All available experience with regard to the working of labour-management co-operation points to a significant conclusion. It is that workers' participation is best secured in terms of advisory functions rather than in decision-making. It is advisory functions that are proving popular and practical and which hold out prospects for the future. Participation in decision-making is still an idealistic concept which falls outside the realm of practical possibility. The reasons are not far to seek.

Participation in decision-making pre-supposes a certain minimum grasp of business economics, the ability and willingness to consider matters from the standpoint of the enterprise and to function as its representatives. Unfortunately, both these possibilities are ruled out by the nature of the present-day industrial community. Workers, though they do display a good deal of common sense and understanding, still lack the necessary knowledge for effective participation in managerial decisions.

For the unions, participation in management raises a delicate problem of dual loyalty. Trade unionism is built up essentially on securing the workers' interests. Unionists are none too keen to have their prestige and power whittled down by engaging in a co-operative endeavour with management, viz., allowing workers to sit on the Board of management of industrial establishment. For instance, in the United Kingdom, the Trades Union Congress is against accepting any direct responsibility in management and it is firmly against the workers being represented on the Management Board. In the nationalised industries, labour leaders have served on the Board of Management only in their individual capacity and not as representatives of the workers.

Industry represents an area of common endeavour wherein both employers and workers have distinct roles to perform. It would be wrong to assume that either party could arbitrarily undertake the functions of the other. In the ultimate analysis, management is the competent authority to decide on management issues; but this should not debar management from listening to the views of workers on various issues. In fact, for improving industrial efficiency, management must provide greater opportunities to workers for expressing their views on the numerous tasks facing the enterprise. Workers cannot make effective suggestions if they are kept in the dark about the various factors affecting the running of the undertaking. Regular supply of relevant information to workers thus becomes a vital element of joint consultation. It is only by encouraging free interchange

of information and ideas that it will be possible to overcome the distance which too often separates employers and workers. Joint consultation gives workers an opportuntiy to influence management decisions and itself amounts to indirect participation in decision-making. In other words, joint consultation should lay emphasis on advisory participation—except in matters where the workers can look after their own interests such as the administration of welfare schemes, canteens, transport facilities and safety measures.

No scheme of joint consultation can succeed if it overlooks the trade unions or encroaches upon their accepted functions. It is, therefore, necessary to establish a sound relationship between the Joint Councils and the trade unions, because lack of support and suspicion on the part of the unions would frustrate all efforts at building up a sound structure of joint consultation. Issues which would come under collective bargaining procedure should be kept out of the purview of Joint Councils. It is preferable that such a programme should be taken up only in those undertakings that have a single, well-established and strong trade union.

For joint consultation to be really effective in large firms, it must start at the primary level. Conditions must be created for consultative relationship between the primary working group and the foremen, chargehands etc. An important cause for break-downs in joint consultation can be traced back to the attitude of middle management. Their attitude towards joint consultation is often characterised by a feeling that in some way it would impair their authority. To overcome this resistance the top management must institute a system of managerial consultation. In India, priority must be given to preparing the ground and educating the workers and the employers about their rights and duties in joint consultation. The programme of Workers' Education recently initiated by the Central Board of Workers' Education has been specially oriented towards educating workers and union officials for various labour-management activities, including participation. The unions have a major responsibility in supplementing the efforts of Government by expanding their own educational programmes for the benefit of their members. In the same manner, enlightened management can also help needy unions to expand their educational activities, without giving the workers any feeling of interference.

More important, perhaps, than management education is the subject of supervisory training and the development of a sound cadre of intermediate leadership. There is a direct and significant relationship between supervisory behaviour and workers' morale. The supervisor acts as the vital link between the top management and the work force. His selection and training are matters of considerable importance, because it is good supervision that can create in the minds of workers a sense of participation in the management of the undertaking. In selecting supervisors, it should be remembered that it is not always the most skilled worker in a group that makes the best foreman. For the supervisor, ability to handle men is as important as experience on the job. On selection, the supervisor must be kept well-informed about the policies of the undertaking through the organisation of conferences and the distribution of bulletins and manuals. Training programmes and conferences designed to develop better management skill in the supervisor should emphasise the handling of industrial relations problems and concentrate on improving human relations.

Education for participation is necessary at all levels in order to make joint consultation 'in-built', that is, it should become a matter of habit in management all along the line. In other words, not

only the workers, but also technicians, junior management and every group that matters has to be taken into confidence before decisions are reached. No decision that the workers consider vital should be reached without joint consultation, even if such consultation amounts, on occasion, to nothing more than an informal talk with the other party. Industrial consultation should be supported by supply of information about the firm and suggestion schemes. While these techniques have great value in large undertakings, they would have limited application in small units. At the same time, small units can afford facilities for more personal contacts as compared with the impersonal way in which matters are handled in larger units. Experience suggests that the feeling of belonging must start in the work-place and may, with advantage, extend upwards. The lowest levels are the most important, because it is here that the effect on the individual is felt the most and because it is on them that higher levels depend.

Sharing information or giving the worker the necessary details is an important aspect of joint consultation. However, since we have not yet reached the point in industrial democracy where everything, including the responsibility, the reward and the risk, is shared equally, it may not be possible for business information to be shared equally with the workers. Some information could leak out and be used by business competitors and, as such, management obviously cannot afford to share such Board Room secrets with the Shop Floor. At the same time, management have a definite responsibility to explain in some detail the reasons for policy decisions and the results that are being achieved. Normally, workers themselves do not appear to be interested in securing information beyond what immediately concerns them. It is doubtful as to how many employees are really keen on understanding, though it is popularly supposed that this is the case. It is only when the workers feel that certain developments are taking place outside their knowledge that they get restive. The regular supply of relevant facts in a form that can be easily understood by the large mass of workers can help to build up mutual confidence. The information supplied should be factual in nature. Apart from verbal presentation of information in Joint Council meetings, information talks, bulletin boards, special booklets and other media should be utilised for sharing information with employees. Well-informed employees develop an interest in their undertaking and such interest leads to efficiency and increased productivity.

It is natural that workmen acquire greater knowledge and experience of working conditions, especially with regard to handling of materials and equipment in the factory. As a result of on-the-job experience, they can make practical suggestions which, if accepted, will not only raise workers' morale but also save many rupees for the company. Full advantage of this possibility should be taken by management by evolving a suitable Suggestion Scheme to stimulate and review all ideas for improving quality, saving time, conserving materials, care of tools and equipment, material salvage, better teamwork, better ways of doing a given job, better routing of rough and finished material, health and saftey, better plant housekeeping, training and upgrading of staff and so on. A Joint Production Committee can focus attention on techniques of productivity improvement, such as methods study, work-measurement, production planning and control, quality control and job evaluation. The importance of the Joint Production Committee lies in the fact that through it, the active association of workers could be secured in the employment of productivity techniques. Whether it is job evaluation or quality control, union participation has the advantage of securing greater under-

standing and acceptance of the proposal. Job evaluation study should be carried out as a co-operative effort. There is often a tendency to create a halo of technicalities around such operation and then argue that workers will be unable to understand their significance. Actually a worker is quite capable of understanding these intricate techniques, especially if in the long run he will be affected. It is, therefore, best to associate him at some stage or other in all such technical studies.

To examine how far the concept of labour management cooperation is feasible in practice, the Ministry of Labour & Employment have sponsored selective case studies. Two such studies—one in the Tata Iron & Steel Company at Jamshedpur and the other in Indian Aluminium Company at Belur Works—have been completed and these throw light on the possibilities and limitations of Joint Consultation. The Tata Study emphasises the point that if workers' confidence is to be gained, management's goodwill for the workers must be translated into concrete terms. At Jamshedpur, adequate wages and good working conditions are supplemented by the performance bonus, the incentive wage and the profit-sharing scheme of the Company which assure the worker a share in the benefits that result from joint endeavour. Other favourable factors listed in the Tata Study as conducive to labour-mangement cooperation are the existence of a strong union, the organisation of joint consultation at various levels and on a wide range of subjects and the development of a satisfactory information service. These bodies discuss matters such as production development, safety and welfare services. Effiective consultation in these joint committees is made possible by the supply of information on various aspects of Company's working and administration. News and notes are discussed through a house magazine, a fortnightly supervisors' news letter, information bulletins and special brochures. Of particular significance is the fact that in addition to its Balance sheet and Annual Report to the share-holders (copies of which can be obtained on request by any interested worker), the Company publishes the Chairman's Annual Report for the benefit of workers, presenting the salient features of the company's working in an easily understandable form and stripped of technicalities. This Report, besides reviewing the work during the year under question, also discusses the company's plans and prospects for the future and gives the workers a preview of the way things are developing. The Tata Study concludes by saying that the experiment in Jamshedpur is working to the advantage of both the parties.

In fact, quite recently, a full-fledged joint Council of Management has been set up at Jamshedpur, where so far labour-management co-operation had been undertaken mainly through independent joint committees. The other study about labour-management cooperation in the Indian Aluminium Company's works at Belur is equally striking for its analysis of the independent union in that company, a union which is not affiliated with any of the four leading all-India organisations of workers. The Belur Union covers only the employees of the works and its officers are drawn exclusively from the works. The union membership roll includes not only the workers, but also the clerical and supervisory staff, several of whom have risen from the ranks. The independence of the union and the inclusion of foremen among its members materially contributes to the success of joint consultation at Belur. Consultation is supported by facts which are themselves jointly ascertained and verified. Information sharing is practised both formally and informally. Official releases provide information on issues discussed in the many joint committees. On the production

side, the union receives a daily efficiency chart, containing rates of production, recovery and effective utilisation of man-power, supplemented by monthly and annual production data. The Joint Committees at Belur are advisory bodies which operate within well-defined areas without impinging on management's power of decision or the union's right to collective bargaining. On the other hand, union-management relations are closely dove-tailed into the system of the joint committees and effectively utilise the latter, while retaining their own independence of action. Judging from the report, labour management co-operation in Belur would appear to flow largely from the foresight of management and leadership of the union. What the Report has to say about the union is particularly instructive: "It has eagerly participated in running the whole apparatus of the collective bargaining system in force in the plant, and on occasions has gone to the extent of issuing a public call to its members to reinforce management goals, for example, whether for increased production, work of quality or discipline in the works. It has also shown great ability in understanding the requirements of informed participation in the decision-making process within the industry. The union has supported the training programmes introduced by management towards this end, and has availed itself fully of the opportunities offered in this regard. As a result the union officials interviewed are fully conscious of the validity as well as the limitations of the various scientific tools that are brought in as aids to management. They are thus adept at the use of the techniques to the point of challenging the figures, demanding a fresh study of exploring further or alternative implications in the data already presented."

In the light of past experience and future hopes, the position about advisory worker participation or joint consultation may be summed up as follows: Most industrial workers today are placed in a situation which, humanly speaking, is oppressive and unsatisfying. This basic situation persists irrespective of whether the worker is in a private firm or a nationalised undertaking since it arises not so much out of the system of ownership, but out of the working and administrative structure of modern industry. It is this suppression of the workers' natural desire for self-expression and craving for recognition which gives rise to workers' resentment which, in turn, finds expression in aggressive collective bargaining. Collective bargaining thus becomes a primitive kind of social institution, where workers are treated as outsiders. It is "a means of protecting and strengthening the workers' collective interest in the process of bargaining about wages and working conditions—bargaining over against the employer. It attempts to get for the workers a larger slice of the production pie." Thus the bargaining table turns out to be a meeting place for antagonists who want to grab as much as possible, each for himself, at the expense of the other and, if one of them cannot grab enough to satisfy him, he resorts to the threat of direct action. Collective bargaining is thus based on sheer power and becomes economically expensive.

Labour Management co-operation, workers' participation in management, joint consultation—all these mean much the same thing and indicate a method of approach which, by recognising the real worth of the workers, will raise collective bargaining to a higher level and base it on facts and for the common good. Its main function is "to increase the size of the production pie. In practice, collective bargaining and joint consultation have often been merged and handled by the same body." In the new order of things, collective bargaining would include not merely wages, working conditions etc., but also intelligent co-operation between the bargaining

parties. Such co-operation cannot be secured if the workers' importance is not recognised and their talents are not utilized. Nor can co-operation be secured merely by statements that the worker must be given a sense of belonging or a feeling of participation. It is necessary to find out the means by which labour can be rewarded for any increase in productivity and to build up around this formula a working relationship between management and labour. Team spirit is also promoted by entrusting the workers with certain administrative and supervisory responsibilities in respect of welfare schemes, safety measures and the like which affect them directly. Delegation of a certain amount of responsibility to labour would also enliven the functioning of joint councils. Once the team-spirit is thus established, it will be found that labour's interest, like management's, lies only in increasing productivity. When the worker is made a player and not just a pawn in a game, he can enjoy this status and his contribution will result in increased productivity and all-round benefits. If an intelligent union leader and a forthright manager could be found, the way is opened up to a new and creative area of industrial relations—the area of joint consultation and mutual interests.

The current proposals for Joint Consultation and Councils of Management are only the culmination of a series of efforts made by Government to bring management and labour closer together, as often as possible, in conferences, committees and discussions across the table in order to develop a team-spirit in industry and to give collective bargaining a new meaning. In the Indian Labour Conference, there are also tri-partite industrial committees for selected industries. These committees and conferences, however, have their limitations. Beyond promoting agreement on broad lines of policy, they cannot be expected to develop that intimate understanding between management and labour so necessary for the smooth day-to-day running of industry. This is a matter entirely for management, workers and supervisors in industrial undertakings. In this country, experience with statutory works committees has not been very encouraging, possibly because the unions were not given sufficient scope and the functions allotted the committees were severely limited. Experience with Works Committees has shown that spontaneous enthusiasm of workers cannot be aroused by restricting the subjects for joint consultation to routine matters such as hygiene and welfare. These are basic requirements which it is obligatory on the employer to provide as part of the employment contract. Something more than this is required if the confidence of workers is to be inspired and their enthusiastic co-operation secured for improving standards of efficiency and raising productivity. That is why it is necessary for the worker to take a more active part in the administration of industrial enterprises.

In conclusion, a word of caution is necessary. If a section of management should think that joint consultation is an easy trick to destroy collective bargaining, they are completely mistaken. Joint consultation cannot be practised that way. On the other hand, management need not go to the other extreme and entertain false fears that workers' participation is a challenge to their managerial authority. This is clearly not the case. Under joint consultation, workers do not question the right of management to manage. They participate only to the extent necessary to ensure that management functions properly and effectively. And this is primarily for the good of the enterprise and for the good of all concerned. Beyond this, workers neither want to nor are they capable of sharing in real management functions. It is only when

their legitimate desire for self-expression is suppressed or is not satisfied that their indignation can take the shape of certain impossible demands on the industry. Such an unpleasant development can be avoided by providing reasonable opportunities for worker participation in management, thus ensuring that the interests of both employers and workers are merged with the interests of the undertaking itself and of the community.

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Industrial Engineering : Its Role in Manufacturing

R F BRUCKART*

Because of the large scale productivity movement now under way in India, manufacturing organisations have shown considerable interest in the introduction of Industrial Engineering function into their concerns. It is now widely recognized to be the most important step in the improvement of productivity. Not all companies, however, understand the importance of an Industrial Engineering department to a programme of productivity. Many concerns are, in fact, not sure what Industrial Engineering exactly is, how it functions, and what it means in attaining improved Productivity. Accordingly, it is necessary first to consider what is meant by Industrial Engineering and the nature of the activities which must be undertaken if this function is to be introduced as an integral part of the organization of a manufacturing company.

Industrial Engineering has been widely adopted in highly industrialized countries as basic to the operation of a manufacturing company. It initially began through the development of work measurement procedures (TIME STUDY) and method study techniques (MOTION STUDY). Industrial Engineering has now a wider scope than in the early days; and newer techniques which have been adopted require a broader definition, of which the American Institute of Industrial Engineers furnishes a good sample: "Industrial Engineering is concerned with the design, improvement and installation of integrated systems of men, material and equipment. It draws upon the specialised knowledge and skill in the mathematical, physical and social sciences, together with the principles and methods of engineering analysis and design to specify the product and evaluate the results to be obtained from such systems."

Industrial Engineering, as we understand it, is largely an American development. It would, therefore, be helpful to observe the trend in industrial engineering in the USA. The growth from 1940 to 1950 of Industrial Engineering in the States can only be called phenomenal, as evidenced from US census figures: the number of industrial engineers increased during the decade from 12,000 to 46,700 — a rise of 376 p.c., compared to a general increase of 51 p.c. in the engineering profession, as a whole. It is thus clear that any activity which in an industrialised country shows such rapid growth must be even more important for a country, such as *India, which is struggling with all its resources to develop its industrial capacity.* One might, therefore, ask what the conditions are, which generate such a need for industrial engineering.

In Indian industry, many operating conditions of inefficiency prevail which are susceptible to the application of in-

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dustrial engineering principles and techniques. The conditions which frequently arise in companies which have not adopted industrial engineering broadly follow this pattern: Management finds its industrial operation unsatisfactory and becomes concerned about its profit level. Although the management may recognize that other opportunities exist for improving the situation through price adjustments, if possible, improved sales methods, wider diversification and by other procedures of this sort, *management eventually looks to operating costs, as the main source for improving the profit picture.* Usually a study of operating costs discloses many areas where there are opportunities for savings through improved efficiency.

Some of the specific conditions of inefficiency commonly encountered in Indian industries are the following: (1) *There is an excessive waste of material and a high scrap loss.* There may be poor yields from materials used, and an unsatisfactory salvage level. Often, there is damage in handling of materials, and poor or little quality control. (2) *Inventories may be too high:* because of this, there is larger sinking of capital than is really necessary. This reflects inadequate Production Schedules and poor planning of procedures in general. (3) *There is poor production planning and control.* The result is an overloading or underloading of equipment, excessive in-process materials, unavoidable delays, and unnecessary emergencies. This results in high labour costs, necessitated by the need for meeting a given time schedule. In many cases, time schedule cannot in fact be established. (4) There is no efficient training, again leading to higher labour costs. (5) *Inadequate instructions and inefficient methods provide a low level of worker application* and general labour inefficiency. (6) *There are excessive overhead costs* which result from waste in the use of available resources and services. (7) *There is a high repair* or *maintenance cost* which is due to breakdowns or failures of equipment and machines. Such breakdowns could be avoided by proper planning and adequate maintenance procedures.

Some of the devices available to Industrial Management for correction of such conditions are: (1) *A simple plan for controlled materials* in the processes where losses frequently occur. (2) *A plan of inventory control* which considers the problems of supply, favourable prices, requirements of production, and a minimum commitment of working capital combined with maximum turnover of product. (3) *Adequate Production Planning and Control* which keeps the material in process moving, and integrates sales orders with raw material supplies. (4) *Incentive wage plans to* stimulate the best effort of labour and supervision. This may be undertaken in a manner by which compensation paid for a given performance is related to the level of output. (5) *A preventive maintenance programme* by which breakdowns and repairs may be anticipated and their occurrence minimised, particularly at critical times. (6) *An overall cost control plan* that provides control simultaneously over all items of manufacturing cost, including material, labour and overhead.

These procedures are all basic parts of an industrial engineering programme. Thus it becomes clear that a vast vacuum exists in many Indian companies which have not yet undertaken an improved productivity programme through the introduction of industrial engineering.

The procedures related to industrial engineering in its early stages of introduction cover such fundamentals as *production, standard setting, methods improvement, plant design and layout, control procedures and cost reduction techniques.*

Development of the standard-setting function usually employs techniques of *motion study and time study* or equivalent procedures. In this country, the term "Work Study" is frequently used to indicate a combination of these two techniques into one working procedure. It is through the use of these two techniques that most Industrial Engineering Departments undertake their first introductory step of a productivity programme. Through the use of method study techniques, current production methods are brought under close scrutiny. From these analyses are derived improved methods and simplified procedures.

Method analysis is carried on through the use of Process Charts and Flow Charts, layout analysis and by utilization of equipment surveys. The Industrial Engineering Department attempts to reduce manufacturing delays, minimises the movement of materials in process and shortens the material handling time. It employs mechanical, pneumatic or other power devices to eliminate unnecessary work and to simplify necessary tasks through an improved sequence of operation. The Industrial Engineering Department utilises the capacity of equipment and facilities to improve the yield from raw materials and the quality of products.

These are typical activities of the Industrial Engineer in the Industrial Engineering Department. They can be adequately performed, only if the basic needs of such a Department are provided for. A few of these requirements are: First, of course, is the necessity for personnel. The Chief Industrial Engineer, or whatever title may be chosen for him, should preferably have been academically educated in Industrial Engineering, although this is not an absolute requirement. Unfortunately, far too few such persons are available in India, considering the magnitude of the country's requirements. Through training courses however, and by acquiring experience with management consulting firms or with private industries, many trained Industrial Engineers have become available to Indian industry.

In the USA, the number of Industrial Engineers employed for given sizes of companies, varies from 1.26 industrial engineers per 100 employees, for plants of over 2,000 employees, to a figure of 3 industrial engineers per 100 employees, for plants of 500 employees or less. In India, a figure of approximately one industrial engineer per 100 employees seems adequate, if a programme of the nature recommended is to be followed. Before actually introducing the system, of course, a properly trained industrial engineer should first be secured or a properly qualified one trained and put to the task of developing a plan for a long range attack on the problems and inefficiencies which exist in the particular company. The areas in which his activities will be undertaken are those pertaining to operational efficiency, plant layout, cost and quality control, man and machine efficiency and resource utilization, production standards fixing, wage incentives and production planning and control.

As far as the physical requirements are concerned, a suitable office must be provided to the Industrial Engineer in or around the shop in which he has to work. Facilities provided should include adequate filing equipment and a proper physical environment in which mental as well as physical work may be undertaken.

He should be provided with all necessary equipment for time and motion study, such as a stop-watch, observations board and forms, with motion picture equipment for the study of work methods if finance permits. A library should be established of the

basic Industrial Engineering text books and hand books, along with some reference texts on the subject of management in general.

In as much as industrial engineering is properly to be regarded as an integral and important part of the Organisation, suitable facilities should be provided in order that the industrial engineer's tasks may be carried out with effectiveness.

Now the Programme: a typical programme followed in Industrial Engineering in an effectively established department may proceed in the following sequence under most conditions:

(1) Introduction of a *Method Study programme* and analysis of all important operating processes for purposes of simplification and increase in efficiency.

(2) Development of *production standards* for the most important processes, following installation of improved methods and simplified procedures.

(3) Introduction of *wage incentives* by which suitable levels of performance may be achieved, based on the production standards established in Step 2.

(4) Introduction of a *production control and inventory control system* by which adequate planning and control systems are installed and put into operation. These also are based on the production standards established in Step 2, and through the application of improved methods developed in Step 1.

(5) The introduction of *quality control procedures.* The nature of the quality control procedures installed is determined by the kind of product produced and of the processes carried out.

(6) *Introduction of control devices, including* a suggestions system, job evaluation, merit rating and product design.

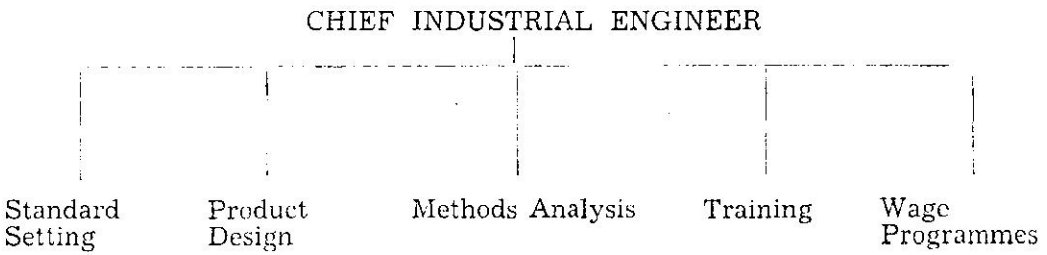
It is observed that the use of techniques of Method and Motion Study are given the highest priority in the introduction of Industrial Engineering techniques. It is common in Indian industry that this is found to be the most critical and important step taken to achieve productivity, and consequently *it is the first step undertaken by the new Industrial Engineering Department.*

Steps 2, 3 and 4 which follow the introduction of Method Study procedures are based on the assumption that Step 1 has been undertaken adequately and properly. It is, to say the least, unwise to undertake an Industrial Engineering Programme without giving priority to the analysis of existing methods and the development of improved methods.

Those who may wish to consider the introduction of an industrial engineering department will wish to know at what level in the Organisation it should function. A survey conducted in the USA in 1957 shows that more industrial engineering departments (43 per cent) report to the general manager of a company than to any other individual. Approximately 25 per cent report to the vice-president or a person of equivalent position. Thus, in 68 per cent of the companies reporting in this survey, industrial engineering departments reported either to the executive at the highest level, or to the manager, one step lower. It is not considered good form to have the Department report to any lower level. In the survey mentioned, only one per cent of companies indicated that their industrial engineering department reported to the supervisor on the shop floor. Thus the high level position of the Department is clearly established.

The department may be organized either on a *functional,* or on a *produc-*

tion basis. A functional organization covers such areas as the following:



Under these sections, (a) *Standard Setting* includes time study; performance rating and measurement of direct and indirect labour. (b) *Method Analysis*: operation analysis; motion study; materials handling and plant layout. (c) *Wage Programmes*: wage incentives; job evaluation; merit rating and wage administration. (d) *Product Design*: tool design; estimating; equipment selection and jig and fixture design. (e) *Training*: personnel selection; operation training and supervisory training.

When organized on a production basis, each department or section may have its own industrial engineering group, performing all of these functions in that area, and coordinated by a central officer under the Chief Industrial Engineer.

One of the most important functions which may be undertaken by the industrial engineering department is to carry out appropriate training programmes. Among the general types of training provided are the following: (a) training for supervisors in Method Study; (b) training for labour representatives in Method and Time Study on an appreciation level; (c) motion study and work simplification training for supervisory personnel; (d) courses in Time Study for various shop supervisors and personnel management in general.

Training in Method Study and Work Simplification is given high priority in training programmes. In the survey referred to earlier, plants reported that 75 per cent gave courses in motion study and work simplification to foremen and supervisors; 30 per cent to factory workers; 26 per cent to office workers and 14 per cent to union officers.

Courses in Time Study were also high in importance in this survey, as 75 per cent of this group reported providing courses for foremen and supervisors, 13 per cent for office workers and 29 per cent for union officers. It need not be said that personnel having inadequate training or unsatisfactory understanding of industrial engineering will clearly be unsuitable for presenting such training programmes.

In the introduction of industrial engineering techniques, it is anticipated that certain actions will be undertaken which affect the attitudes and behaviour of workers on the shop floor. The work of the industrial engineer creates new circumstances which have a very direct effect on the livelihood and welfare of the workers in the factory. Because of this, certain human reactions must be anticipated, and notable limitations on the activities of the industrial engineer must be observed. Among

the most common limitations are the following:

(1) The industrial engineer must avoid any actions which create unanticipated worker redundancy. He must avoid creating surplus personnel which must be released or moved from one job situation to another, without having prepared for their disposition before-hand in a satisfactory manner. (2) An industrial engineering programme must be introduced with full communication of the programme to the workers concerned. (3) The industrial engineer must collaborate in all respects with supervision and management in order to achieve an effective working programme. (4) Introduction of industrial engineering techniques is best done where human relations already existing are good, although this is not an absolute limitation. (5) The industrial engineer must not confuse the methods programme, or the development of increased worker efficiency, with what is commonly referred to as "speed up". Nor should he be expected to secure increased output and better quality without suitable rewards to the workers involved. The philosophy of *quid pro quo* should prevail. For instance, when increased effort is given by the shop worker to secure increases in output, he should be rewarded with remuneration related to the level of performance provided. (6) The industrial engineer must avoid a rush to adopt wage incentives without a preliminary programme of method study and work simplification. Many dangers exist in too quick an introduction of wage incentives, particularly those introduced without a sound basis of efficient methods and well designed working procedures. (7) A system must be established as an integral part of the industrial engineering programme to distribute the benefits of increased productivity to those who have contributed to it.

In summation, it may be said that certain basic principles and rules must be agreed upon at the outset if the introduction of an industrial engineering department is to be carried out efficiently. (1) There should be agreement among all concerned in management that Industrial Engineering is sound and effective. Management must be convinced that industrial engineering can be applied to the operations of the company concerned. (2) The introductory step may well be modest. *It should not be all-inclusive,* but should be concerned with selected areas, operations and processes, chosen to solve the most critical among the existing operational problems. (3) Each step taken by the industrial engineer should satisfy a felt need of the company. (4) *The programme should pay for itself.* (5) Competent industrial engineering personnel should be chosen and permitted to work full time on industrial engineering activities without being burdened by interference from requirements of other responsibilities. (6) The programme when launched should have the full support of all management personnel concerned.

Industrial Engineering has demonstrated its usefulness throughout industry in all highly industrialised countries. Any company of more than 50 employees is probably already applying some of the principles and techniques which normally fall within the scope of industrial engineering. These techniques and principles may be applied informally, and by names other than those employed in Industrial Engineering. The widespread use of these techniques indicates the desirability of a well-established installation and proper application of efficiency procedures. Industrial Engineering provides the means for undertaking objective analysis of the major problems of production, costs, quality and efficiency in

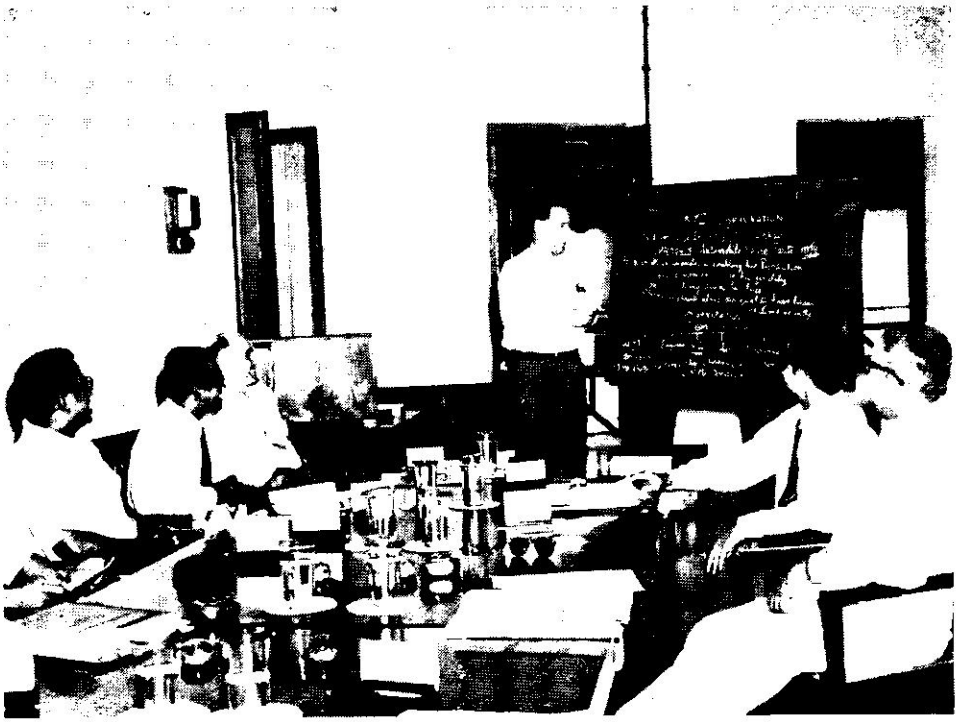
general. In undertaking such a programme it is necessary for a company to identify and define the projects to be undertaken, after which priorities may be established on the basis of needs and potential savings. These projects should then be undertaken and solved, *one at a time.*

The first project undertaken in Industrial Engineering should be modest, and should be one that can be completed quickly and which will show savings in a short time.

Successive projects should then be undertaken, also based on need and economic potential. Fortunately, Industrial Engineering results may frequently be measured in objective terms of rupees saved and thereby *it may be demonstrated that the application of scientific management will pay for itself.*

An industrialist contemplating the introduction of an Industrial Engineering Department should *not view it as additional overhead,* an added expense to be paid out of profits which are already meagre. *Rather, industrial engineering must be viewed as an investment.* It is an investment which in normal circumstances will readily return all it costs through savings in a relatively short-time and several times over. In fact, the Industrial Engineer should in any company be able to demonstrate annually tangible savings, *at least twice the cost involved in maintaining the department.* If an intelligent, competent and hard-working Industrial Engineer is unable to show such savings, then there is something wrong somewhere, which needs to be seriously inquired into and corrected. The potential is available in most Indian companies, and needs only to be exploited.

We might conclude, in fact, that any company in India that needs Industrial Engineering is already for it through waste and general inefficiency which industrial engineering techniques could eliminate. Assuming a favourable social environment, techniques can ensure economic survival through boosting output, slashing unit costs and smoothening the plan of work. Those who have considered the introduction of Productivity department, or Industrial Engineering department, but have not yet acted on the matter should now proceed to adopt this modern management tool. Indian industry is on the move. Those who wish to keep in step can no longer afford to delay its full adoption, for *devil take the hindmost.*



Mr. Ellis O' Keller of NPC conducting the course on Conference Leadership at Madras

Dr. P V Cherian, Chairman, Madras Legislative Council, delivering the Inaugural Speech at the Appreciation Course on Materials Handling, organized by the Mad

Productivity Conference organized by NPC Regional Directorate, Kanpur

A section of the audience in Mr. John Marsh's seminar on Human Problems in

The NPC

THE crowded photographs, facing this page, are indicative of the stage reached in the Productivity Movement, organised under the *aegis* of NPC. At the time of writing, NPC specialists are conducting a Junior Managers' Course at Bombay. It was first inaugurated at Kanpur and the reports that are coming in of the sessions at Kanpur and later at Delhi are fairly encouraging. The account that follows of the seminars and conferences and training programmes organised by Local Productivity Councils associated with the NPC are evidences of a forward movement. The fact that courses are being conducted in regional languages (Tamil, for example) is significant: the productivity movement is going along firm ground. Steps are being taken to organise in-country teams. Actually a team organised by the Delhi Productivity Council has visited the Calcutta industrial region. Another team organized by the Madras Council was scheduled to go round, about the end of January 1960. A Team sponsored by the Rohilkhand Productivity Council visited Delhi about mid-January, to study small scale industries, in and around the capital. This is a healthy development. For good reasons, we have so far been looking out for productivity techniques. It was not expected that a time would so soon come in the history of the Productivity Movement that in-country teams would be going round. As it is, a beginning has been made; and the prospects for growth from within appear to be fairly good.

THE small number of specialists associated with the NPC have also been going round the country, discussing with industrialists, on the spot, problems relating to cost reduction, elimination of waste, techniques of work study, materials handling, process and scrap control etc. Last month, 24 industrial units in Bangalore, Madras, Bombay, Calcutta and Kanpur regions were visited by NPC specialists.

THE volume of technical enquiries received in the NPC is on the increase. The demand for technical information on manufacturing processes has grown to an extent that NPC has had to tap outside sources, particularly the ICA, Washington. It will require time and effort to develop internal resources to meet the growing demand for technical information.

THE highest priority in the NPC schedule of activities is on the development of training programmes which would suit all levels of industry. To begin with, a nine-week Course on Work Study was prepared and conducted at Delhi and Faridabad, with a view to produce a broad appreciation of the nature and value of work study techniques and to stimulate firms to use them. Senior and middle executives, trade union officials, shop stewards and apprentices took part in the sessions, which included lectures, discussions, film-shows and practical exercises. This 9-week course on Work Study is now being conducted at Kanpur. It began towards the end of December 1959 and will go on upto the end of February 1960. The first phase of the course, which included the presentation of work study techniques to the 26 participants—engineers, managers, labour representatives—is over. The trainees will now go back to their own plants and work out, again under the

guidance of NPC specialists, the work study techniques that they have been taught. They will then gather together and make out a report of their experiences. *So a fairly good amount of work is being done at the ground level.* This course is scheduled to be conducted at Calcutta about the beginning of February 1960. Another course on Time Study, Job Evaluation and Incentive Schemes is under preparation and might well start at Delhi in April 1960.

THE next phase of the training programme relates to managerial and supervisory personnel. The need for trained managerial and supervisory personnel at the plant level is obvious in the interest of higher productivity. NPC is accordingly concentrating its attention on providing training for these two categories of industrial personnel. The Junior Managers' course to which a reference has been made in the opening paragraph, is now having its run at Bombay. It will then go down south to Madurai and Madras and subsequently come to Ahmedabad. Preparatory work on the two-week Supervisory Course is nearly over; it will soon be sent round the country for experimentation.

NO training, however, can really succeed in full measure, unless it has the blessing and cooperation of top management. Their participation in training programmes is proposed to be secured by associating them in appreciation seminars and talks, as a more or less regular part of NPC training programme. The primary objective of securing participation at this level is to derive the full benefit from their cumulative experience. Among the topics on which seminars are proposed to be arranged are: plant layout and materials handling, production planning and control, cost and budgetary control, stores control and inspection and quality control.

IN the programme of NPC, Local Productivity Councils (LPCs) play a very important role, as it is through these councils that NPC seeks to implement its programme. With a view to discussing the role of LPCs in the productivity drive, and the steps to be taken for closer co-ordination between LPCs and the NPC, a meeting of all LPCs has been convened in Delhi in February. The meeting will consider, *inter alia,* how best to ensure effective participation of professional organisations, management associations, technical and educational institutions and foreign experts, in productivity programmes.

LPCs provide a forum where employers and workers can explore the large area of common ground and organise a growing interchange of experience between firms in the area. This interchange may take the form of carefully thought-out and planned inter-firm visits, called in productivity terminology as the circuit scheme. Most LPCs have also organised lectures and discussions on broader issues of productivity and achievements of individual firms through experimentation in new techniques and methods. Following is a brief account of LPC activities in the various sectors of the Productivity Movement.

THE Kanpur Productivity Council has had, during the last few months, a fairly crowded programme: (a) a Junior Managers' course conducted by Mr. Ellis O'Keller; (b) three symposia on the role of managers, supervisors and labour, in Work Study; (c) a talk on New Facets of Management by Mrs. Mary Cushing Niles—American management expert and consultant; and (d) a nine-week basic course on Work Study, conducted by Prof. Bruckart and Sri Duleep Singh of NPC.

THE Baroda Productivity Council recently organised, in collaboration with Small Industries Service Institute, a course on Business Management for small industries. The Council has also conducted a course on Marketing Management. Its future programme includes training courses on (a) sales management (b) production planning

(c) management accounting (d) cost control in textile industry (e) statistical techniques in industry and (f) workers' education. It has formed one circuit on materials handling, which has visited nine factories, and sponsored an in-country productivity team to visit textile mills in Madras, Madurai, Coimbatore and Bangalore.

THE Mysore State Council has organised a five-day course on industrial relations for trade union personnel. Circuits on materials handling and welfare have been formed. Under the auspices of the Council, Mrs. Mary Cushing Niles gave a talk on Developing the Manager. The Council's programme for the coming months includes (a) an appreciation course on productivity, with particular reference to Work Study (in Tamil) (b) a five-day course on Job Relations to be conducted by Mr. Anderson, TWI expert (c) a course on Job Instructions and Job Methods (d) another course on industrial enterprises: their organisation and structure and (e) history of trade union movement.

THE Kerala State Council organized a course on Supervisory Training, and a talk on Essentials of Management by Mrs. Mary Cushing Niles. The Council intends to arrange a talk on Human Relations by Mr. Ven Kennedy and courses on Quality Control, Selection and Placement and Work Study. There is a proposal to organise a circuit of labour representatives in the public sector enterprises in Madras. Two In-Country Productivity Teams may also be sent round. A sub-committee has been set up to collect data relating to productivity in various industries and to suggest methods of improvement.

THE Madras Productivity Council's recent programme may be summarized as under: (a) one-week course on Work Study—second part (b) course on Marketing Management: Principles and Practices (c) lectures by Mrs. Mary Cushing Niles on (i) Practice of Management—some recent developments (ii) Human Relations and Productivity and (iii) Executive Training (d) a seminar on Higher Management, in which Mr. Edwin H. Schmitz, Chief, Industry Division, TCM, participated. The future programme of the Council includes a three-week Junior Managers' Course to be conducted by Mr. Ellis O'Keller of NPC. The circuits, formed by the Council, are continuing their visits to factories. The composition of an In-country Productivity Team on Industrial Relations is also being finalised.

IN collaboration with the Directorate of Factories and NPC regional directorate, the Calcutta Productivity Council conducted a course on Industrial Safety. The Council has the following programme for the next three months: (a) a course on Work Study and (b) two conferences on the first Productivity Team Report and Work Study. Mr. R N Currie, Head of the Work Study Department of ICI (UK) will participate in the Conference on Work Study.

UNDER the joint auspices of the Coimbatore Productivity Council and the Institute of Management, Mrs. Mary Cushing Niles gave talks on Human Relations in Management. The Council is organising a one-week course on Production Planning and Control and a three-week Junior Managers' Course.

THE work of the Delhi Productivity Council has already been referred to: (a) three-week Junior Managers' Course conducted by Mr. Ellis O'Keller (b) an In-Country Team sent out to study materials handling and human relations in the Calcutta region. The council is shortly organizing inter-plant visits to factories in Delhi region to study productivity techniques.

THE Andhra Productivity Council organised a four-week basic course in Statistical Quality Control at Hyderabad

and proposes to have a six-week course in Work Study, in February.

SRI Manubhai Shah, Union Minister of Industry and President of NPC, will inaugurate the Indore Productivity Council on 26 February 1960. A Conference on Productivity is also scheduled to be organised by the Council on the occasion.

THE Ludhiana Productivity Council recently conducted a short course on cost accounting. The Council has a project of sending round a 12-member in-country productivity team (for cycle industry) to study plant layout, materials handling, quality and cost control and incentives.

THE Mysore District Council recently held a seminar on location of industry. It proposes to conduct a course on industrial relations for trade union personnel and another three-day course on cost control.

THE recent programme of the Madurai Productivity Council included talks on Human Relations in Management by Mrs. Mary Cushing Niles and a seminar on Problem Solving in which Mr. Edwin H. Schmitz participated. The council is shortly organizing a course on Selection and Placement.

THE programme of the Salem Productivity Council for the year 1960-61 includes (a) training courses in cost and budgetary controls (b) work study (c) production planning & control (d) quality control (e) organisation and principles of trade unions and (f) seminars on joint consultation, wage incentives and industrial safety. A field investigation on job evaluation is also being arranged by the Council. The Tirachuripalli Productivity Council held a seminar on Higher Management, in which Mr. Edwin H. Schmitz participated. The subjects discussed at the seminar were: management principles and practices and management techniques for increased productivity. The future programme of the Council includes a course for supervisory personnel, another one-week course in work-study and a two-day labour seminar.

SIMILAR programmes have also been arranged by other productivity councils: Assam, Amritsar, Jaipur, Jamshedpur, Rajkot and Surat. While the Amritsar Council recently organised a three-day course on cost accounting, its counterpart in Assam held a five-day course on basic supervision. The Jaipur and Rajkot Productivity Councils conducted courses on stores reorganization. Courses in TWI and Work Study will shortly be organised by the Jaipur Productivity Council. The Jamshedpur Productivity Council, which was recently inaugurated by the Chief Minister of Bihar, arranged talks by Mr. John Marsh, under the joint auspices of the Council, TISCO and Xavier's Labour Relations Institute. The Surat Productivity Council has plans to hold a three-week course on methods study.

A NUMBER of institutions deal with subjects relating to industrial productivity. Of late, these organisations have stepped up their activities considerably. A brief account of their activities is given below :

THE Ahmedabad Textile Industries Research Association (ATIRA) organised a three-week course on Executive Development—Patterns and Practices, conducted by Mr. John Marsh. He also delivered a lecture on Human Relations Problems in Management. A symposium on Recent Trends in Machinery Designing, as seen at the Milan Fair, was recently held under the joint auspices of the local Textile Association and ATIRA. The latter has completed a survey of production and personnel in the Chemical Processing Departments of 26 selected textile mills in Ahmedabad.

THE All-India Manufacturers' Organization (AIMO), Bombay, arranged talks on problems of productivity by Sri Pra-

bhu Mehta, who led the NPC-sponsored Productivity Study Team for Textiles. Under the joint auspices of AIMO, Rotary Club and the Cotton Textiles Export Promotion Council, Sri Mehta gave another talk on his experiences abroad in respect of preventive maintenance and productivity.

THE Institute of Industrial Engineers, Bombay, proposes to sponsor a Team to study the working of Industrial Engineering Departments of various industrial units in Bombay. A conference on Public Relations was organised by the Bombay Management Association. Under its auspices, Mr. John Marsh gave a talk on Impact of Industrialisation in Developing Countries.

THE third Refresher Course on Job Relations was recently inaugurated at the Indian Institute of Personnel Management, Calcutta. The Institute proposes holding another course on Job Relations, a Refresher Course for Personnel Managers and a course on Conference Leadership. The Calcutta Management Association is currently conducting an Advanced Management Course for Top Management.

A TWO-DAY seminar on Office Management was held under the auspices of the Madras Institute of Management. Among the subjects discussed at the seminar were: Office Management as a Profession and Work Simplification in Office. The Small Industries Service Institute, Madras, arranged lectures on Production Planning and Control and Work Study for the trainees of Business Management course. The Institute will shortly commence its seventh Course in Business Management for small industries. The Small Scale Industries Association, Madras, is holding a seminar on Development of Small-Scale Industries. It will be inaugurated by Sri Manubhai Shah, Union Minister of Industry.

THE Indian Standards Institution recently held a one-week Convention at Hyderabad. The sessions on Standardization as a Pre-Requisite to Productivity was inaugurated by Dr. P S Lokanathan, Chairman of NPC. At Bangalore, Mr. John Marsh gave a talk on Executive Development—Patterns and Practices, under the auspices of the Indian Institute of Science; another talk on Human Relations—Trend in the UK, under the joint auspices of the Management Science Association, Operation Research Association and Mysore City Productivity Council. Mrs. Mary Cushing Niles, who has been in India for quite some time, conducted a seminar at Bangalore, under the auspices of the local Institute of Management, on General Management Problems of an Expanding Industry, and Organisation for Development of Executives and Staff.

A SERIES of training courses, seminars and lectures are being currently conducted by quite a few other organisations, associated with the productivity movement. Prominent among them are: Indian Statistical Institute, and Indian Society for Quality Control, Calcutta; Small Industries Service Institute, Kanpur (five-week course in Business Management); Madras Psychological Society (two-day seminar on industrial psychology); Labour Research Bureau, Kanpur (Talk on Labour and Productivity); and Roorkee University (Talks by NPC specialist on refresher course in mechanical engineering).

WITH regard to Productivity Teams, sponsored by NPC for making an intensive, short-term study of advanced technical know-how, as it obtains in the USA, Western Europe and Japan, the position is as follows: all the seven productivity teams, scheduled for 1959-60, have gone round and returned. Arrangements are being made for sponsoring 15 teams under TCM aid during 1960-61. The NPC Foreign Technical Assistance Committee (FTAC) has taken decisions on the composition, itinerary and terms of reference of

seven teams, dealing with (i) Industrial Maintenance (ii) Industrial Safety (iii) Plant Layout (iv) Training in Supervisory Control (v) Incentives in Industry (vi) Marketing and Distribution and (vii) Cost Accounting and Financial Control.

In the end, it is probably worthwhile to re-emphasize the value, in terms of productivity, of NPC's training programmes. The photographs facing page 26 speak for themselves.

European Productivity Agency

AFTER World War II, the whole of Western Europe began to realise that it would soon be outdistanced by the extremely rapid expansion of the great economic powers, particularly the United States. Many measures were taken, with massive assistance of the USA, through Marshall Aid, to retrieve the heavy war-time losses and to push up Europe to a position of economic influence and power in the post-war world.

The establishment of European Productivity Agency (EPA) though it came somewhat late, was one of the important measures taken to strengthen the European economy. On March 26, 1953, the Council of OEEC (Organisation of European Economic Cooperation) decided to establish the EPA. The Council's decision was prompted by the US Government placing $100 million at the disposal of Western Europe, with an additional present of $2.5 million to the OEEC. These financial arrangements were the result of an amendment to the Second Mutual Security Act, to furnish Europe with sufficient funds to run a productivity campaign.

Countries could use the funds allocated to them either for making loans to firms for modernisation purposes or for the direct financing of a productivity programme. The sums allocated to the OEEC allowed it to set up the executive bodies which had become necessary for its productivity work. Thus the European Productivity Agency was established. Its three main components were the PRA Committee, the Directorate with its secretariat and an Advisory Board composed of independent personalities who would provide direct contact with influential non-governmental opinion.

EPA's existence is bound up with that of the national productivity centres, whom it must assist; and its programme has to be planned as a complement to national programmes. Encouragement, guidance and co-ordination may be provided at national level by non-governmental organisations and specialized agencies of a public, semi-public or private character, but it would be unrealistic to expect an international institution to exert effective influence on the individual firm. *Productivity can only be increased by efforts made by the firms themselves, under the leadership of management and with the co-operation of all grades of staff.*

When the Agency was born, Europe's economic recovery had almost been achieved but the pre-occupations of this period still held sway. The main endeavour was to make up the ground lost in Europe during the war by sending study missions to the United States and appealing for American experts. Although the high productivity in American firms was known to be due just as much to operating conditions as to technical progress and that technical arrears were in any case the easier to make up, there was still a tendency to devote a great deal of effort to studying technological problems.

On this last point, there was a very definite revision of policy when the Agency's Second Annual Programme was framed (1954-55). It was then decided that technological projects

should be undertaken only in very special cases. The Agency's programme, and those of most national centres, therefore concentrated mainly *on management problems and the establishment of an atmosphere of cooperation between management and labour.*

Moreover, after a fairly considerable number of research projects had been launched in the economic and sociological fields, this type of activity was reduced, first in the Third Annual Programme (1955-56) and then even more decisively in the Fourth Annual Programme (1956-57).

To continue on these lines would have meant diverting the Agency more and more from the study of general problems of productivity. In addition, countries with large underdeveloped areas were taking less and less part in the Agency's work, and it was plain that projects were not suited to their requirements. The question even arose *whether the concept of productivity, as it had developed in regard to full employment economies, held good for countries where unemployment was still endemic.* By including a section in its Third Annual Programme (1955-56) entitled "Under-developed Areas," the Agency set out to tackle a problem which by its nature and extent went beyond the level of the individual firm.

By the time, the Fourth and particularly the Fifth Annual Programmes (1956-57 and 1957-58) were completed. European economic recovery had been definitely accomplished and Europe's next problem was to forge ahead at the same rate as other parts of the world.

Scientific discoveries over the past twenty years pointed to a further rapid expansion in technical progress; if Europe did not make the most of the opportunities offered, she would be definitely outdistanced. Furthermore, such new economic structures as the Common Market and the Free Trade Area which are now taking shape will create problems of adaptation for all sectors of the economy; the national productivity centres and the Agency will have to help. Consequently, while pursuing activities already begun with the aim of increasing industrial productivity under the existing economic system, the Agency — and the national centres — must study *the conditions necessary for technical progress*, work to create those conditions, and also endeavour to foresee the consequences.

This means that technological problems will again become important, not in themselves but in their economic, sociological and human aspects, and that research will have to be given a prominent place in the Agency's programme, since the problems are new and must be studied before action can be taken. And, finally, it means that attention will have to be devoted to very general questions, such as the *adaptation of education to the requirements of modern economy,* which are as much a matter for governments, the principal universities and the professional organisations, as for productivity specialists.

Against this background, the general activities of EPA may now be summarized: 1. Management: (a) Dissemination of management techniques (conducting short-term seminars etc); (b) Management education: (organizing meetings of directors of management training centres; training sessions in the USA etc.); (c) Dissemination of distribution techniques: (advisory service; organizing study teams for USA, training sessions in the USA for distribution and marketing consultants).

During the four years under review, the EPA organized 340 training courses in management techniques (with 15,000 participants); 1 mission to the USA (with 20 participants); 15 courses for teachers in the USA (with 144 partici-

pants); 3 summer schools (with 70 participants); 7 international conferences on management (with 490 participants); 3 international conferences on distribution (with 330 participants); 40 reports on management; 16 reports on distribution; 128 seminars on distribution (with 7,071 participants); 5 missions to the USA on distribution (with 147 participants). 2. Employee Training: (a) Vocational training (b) Foreman training (organizing training sessions in the USA for employee training specialists). 3. Trade union Programme: The Agency's early work in connection with training consisted solely in helping a number of national projects for the advanced training of trade union leaders by giving technical advice on the preparation of courses or by supplying *rapporteurs* and lecturers. But these activities gradually took on an entirely different aspect. For example, in countries faced with particular difficulties, the Agency has organized special courses for instructors. In Greece, where there was practically no trade union training programme, Agency consultants have themselves organized local courses of this kind and their efforts have enabled a wide system of training to be built up throughout the country.

Thanks to a subsidy from the Ford Foundation, a number of young European trade unionists have been able to take part in three month courses at Harvard University, which, at the request of the Agency, modified its courses to include comparative studies. As a result of the experience gained at Harvard, a course on modern methods of business management and administration, reserved for European trade union technicians, has been instituted at the University of Columbia.

During the past three years, the Agency has also organized international trade union seminars. Each is prepared by a group of specialists who write reports to be used as the basis for discussion and present them orally. At the end of the seminar, a final report is compiled, which may take the form of a brochure for the use of the national trade union training centres.

Group travel between Member countries is another feature of the Programme. The National Productivity Centre and local trade union federations and branches in the host country are responsible for the visitors' reception. Factory visits, including exchanges of views with shop stewards and local trade union representatives, are arranged and various public bodies, such as the Ministry of Labour, are invited to organize general lectures. Members of such a group may also take part in a training programme. Representatives of countries where trade union instruction is only in its early stages may be invited to visit a country where preparation for union work has reached an advanced stage. During the first years of the Agency's life, 700 trade union officials took part in inter-European visits. The Agency also organizes, with the help of the American authorities, trade union missions to the United States. Four such missions, each lasting six weeks, have been organized. During the four years under review, the EPA has organized 242 Intra-European missions; 6 courses in American universities; and 12 international seminars, besides providing 130 consultants for technical assistance and publication of 17 trade union information bulletins and 35 brochures.

Attention has also been paid to the development and use of applied research: (a) Co-operative research on, for example, use of oxygen-enriched air in the iron and steel industry; gasification of solid fuel; long-distance transport of gas, use of wind power; manufacture of phosphate fertilisers without sulphuric acid; mixture of man-made fibres with wool; new coking processes; use of low-grade ores etc.

It can, indeed, be said that the process of co-operative research is in itself even more important than the subjects which have been studied up to date. It is entirely new in Europe, and can be extended to fields other than those dealing with technical matters, such as economic research and research into the human sciences and their application to industry. It will no doubt play an important part in connection with the expansion of the European market.

From the outset, the Agency had at its service a network which it has had to assist: (a) by helping technical information services to improve their methods; (b) by perfecting new methods of information, intended mainly for small and medium-sized firms; (c) by pointing out the value of Russian scientific and technical literature and taking action to make it available if required; (d) by exercising a certain amount of persuasion on business circles. During the four years under review, the EPA has organised 10 projects on joint research; 5 international conferences; 10 seminars on applied research; published 2500 European technical digests in 38 monthly bulletins; 8 reports on research and 20 technical reports on productivity measurement and the study of economic features of productivity, 13 Productivity Measurement Reviews (with 4 supplements) and 12 economic reports have been published.

In specific economic sectors, the following work has been done: (i) Building: Study on modular co-ordination; mechanization of building operation; production and distribution of concrete; work planning in building industry etc. (ii) Other industries: Organizing study missions to USA; powder metallurgy, automobile industry, traffic engineering and control, etc.; exchange of study missions in Europe, on welding techniques etc; survey on materials handling, water economy in iron and steel industry, rational use of timber etc. (iii) Agriculture: Marketing specialists' conference; advisory service; vocational training; advanced training for specialists; technical information service; dissemination of technical progress in agriculture.

In addition, the Agency had had to undertake activities which have a more general purpose as for example, research and study on conditions and consequences of increased automation and on how to adjust education to the requirements of modern economy; also technical aid is extended, through the assignment of specialists to areas in Europe in the process of economic development.

For its working expenditure the Agency draws on a capital fund from which the necessary amounts are allocated year by year. That is to say, it is not subject to the vote of an annual grant based on a budget, with any unspent surplus being withdrawn. Capital was initially provided from two sources: $2.5 million (already referred to) paid by the USA to OEEC for the purpose, plus payments made by member countries benefiting from Benton Moody aid to the extent of 8 per cent of counterpart funds, resulting from US aid. Originally, most of the payments in national currency were only partially convertible, and the remainder, although the property of the Agency, could be spent only in the currency of the country concerned. This rule was progressively relaxed, and from July 1, 1957, all payments in national currency have become convertible. The initial capital from these two sources amounted to approximately 4,000 million in French francs. In each financial year from 1953-54 to 1956-57 inclusive, the OEEC paid 150 million French francs into the Agency funds, a sum representing part of the Organization's budget which was spent on work relating to productivity before the Agency

was formed. This payment was prompted by the desire that the whole capital should be employed on activities which the OEEC had previously been unable to undertake.

When it was decided to continue the Agency's activities after July 1, 1957, member countries undertook to subscribe annually, for at least three years, a total of about 600 million French francs. Other income comes from interest on investments and miscellaneous receipts, e.g., from the sale of publications. Discussions are also in progress with the "observer" countries, with a view to fixing annual lumpsum contributions to cover their participation in projects. Over and above their initial contribution, the US authorities have so far made a special contribution averaging annually about $1.5 million. Since 1956-57, there has been a radical change in the method of allocating special aid from the USA. It is no longer granted through the reimbursement of specific costs but takes the form of an annual contribution, which is also paid into the Agency funds. But it is not fully merged with the rest of those funds. First, the major part must be spent in dollars, and secondly, although it need no longer be used for carrying out projects designated by the US authorities, it must be devoted to certain sections of the programme, agreed with them. In 1956-57, Canada, in turn, decided to make a grant of $20,000 (Canadian dollars) on the same principle as the special aid forthcoming from the USA.

The changing pattern of European economy is bound to affect future activities of the Agency and of the National Productivity Centres. The development of a European market — whether it be of six or more countries — will mean a reorientation and adaptation of programmes to take into account the effects of European economic integration. There will be an even greater need for higher productivity in firms of all sizes, for competition will be fiercer, and efficiency will be the key to survival in both production and distribution of goods and services.

★

It is an era of great opportunities for raising decisively the level of productivity. But the opportunities will not be realised unless the re-equipment of our minds, to meet the problems and seize the opportunities of the new era, matches the scope and scale of the drive to re-equip our factories. We must see to it that when we junk the old machinery, outmoded concepts, prejudices and fears go with it and are not left lying around like scrap on the shop floor to obstruct the progress of the new age.

James Crawford

Time and Motion Study*

TIME AS A MEASURE OF WORK

WHEN we talk of men (labour) as a factor of production, what we mean is that complex of skill and effort which is exercised by each of the men for the accomplishment of any assigned task. From very early times this skill and effort have been subjected to measurement and control in terms of work done. A common measure of work is the quantity of output. This is a convenient and simple measure and is, therefore, widely accepted.

However, the measurement of work in terms of quantity of work done has the following disadvantages: (i) The quantity produced is very much a function of the method employed and therefore variations in method render the measurement unreliable without adjustment which, if made at all, is arbitrary. (ii) There is no means of comparing the work done on different jobs as the measure itself is peculiar to each job and, therefore, varies from job to job. (iii) Even on any specific job, while the quantity of output gives a measure of the work actually done, it does not give any indication of how this compares with the potential or the standard to be expected. This gives rise to the situation where past output determines the apparent standard which itself becomes distorted with every change in method or product. Much of the low productivity of labour in our factories has arisen on account of this unconscious process of building standards on past performances and being never able to adjust accurately for changes.

Another variation of the same method of measurement is the expression of labour required per unit of product. For example, in the soap industry there is a man-hours per ton ratio commonly used for expressing labour effectiveness. While this is a useful measure of labour usage in the industry, it has the following serious limitations if used as a measure of labour efficiency or productivity: (i) Man-hours per ton is a function of the method employed. For example, the more one mechanises a factory, the less will be the man-hours per ton irrespective of whether labour efficiency improves or not. (ii) It is also a function of the composition of tonnage of the product. Generally speaking, smaller packages of the same product will require more man-hours per ton. (iii) In a factory there are many indirect workers whose numbers do not vary in proportion to the volume of production. Therefore the man-hours per ton ratio tends to improve with higher volumes of production, irrespective of labour efficiency.

Thus the commonly accepted measures of labour productivity are inadequate and can indeed be misleading in some cases. What is required is a common measure which can be applied to all types of work. This should be more like the use of pounds as a common measure of weight or of yards as a common measure of length. Whether it is cotton or steel, or wood or cement we have common measures of weight or of length. The ideal will be to have a similar measure for work. And this is the object of Work Measurement—to provide a common measure applicable to all forms of work so that it can be qualified for purposes of management and control.

This common measure has been found to be 'Time' because for doing

* Prepared by the Methods Study Department, Hindustan Lever Ltd.

any job one takes a certain time and then for recouping from the fatigue caused by the work again one takes a certain time. Therefore, it is possible to convert and express all work in terms of Time. This is the basic philosophy of all time study procedures, the variations being only in the techniques of computing the time. Time Study procedure may therefore be first considered in its basic form. Refinements which aim at obtaining more accurate results, may later be considered.

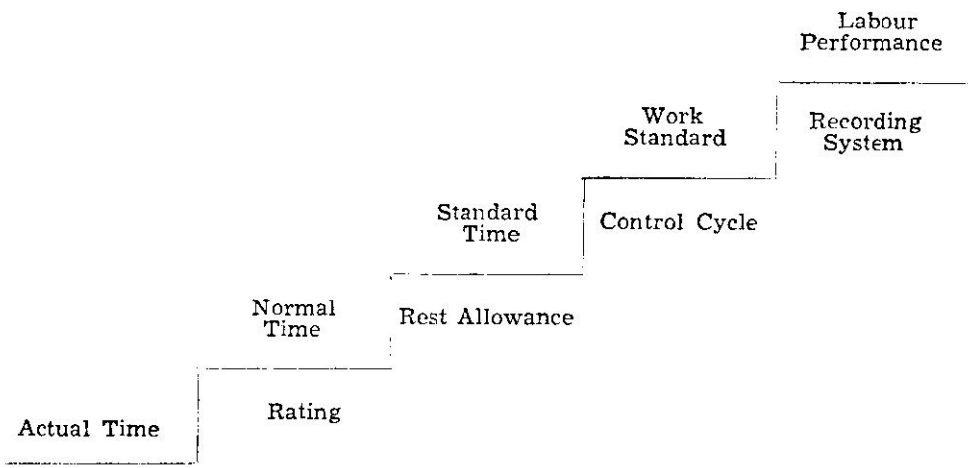
TIME STUDY PROCEDURE

The object of Time Study is to determine the length of time (including adequate rest and process allowances) that will be required for accomplishing a given task. The unit of time adopted is the Standard Minute (SM) which is one minute composed of work and related allowance. In the case of most production jobs therefore the object will be to determine the SMS required for the production of any given unit of output. This is called the 'Standard' for the work or a Work Standard. Such standards will enable us to convert output (production) of various items into a common measure of SMS. This basic procedure in Time Study may be outlined in the following steps built upwards :

The measurement of actual time has to be preceded by two essential steps viz., (a) the analysis of a 'job' into its component 'operations' and of each such operation into its constituent 'elements' and (b) an examination of the method employed for performing each element. These steps are vitally necessary; yet one is so often tempted to forego them that it is considered necessary to describe their importance in greater detail.

Analysis of the Job: Every detail regarding the job (e.g. particulars of the materials and machinery used etc.) should be recorded, however obvious they might appear to be. This is to ensure that nothing is left to the memory of the observer who might either forget or be unavailable at a later date. These details will be useful not only for identification of the job, but also to spot variations at a later date.

Apart from such details a systematic analysis of the job into operations and elements is also necessary. A 'job' may be defined as the task assigned to a worker or a team of workers and consisting of several 'operations' which are carried out in stages by the worker or by various members of the team. Each operation, in turn, involves several smaller constituents each of which has a definite beginning and a precise ending and is called an 'element.'



For example, a job like 'stamping and wrapping of soap by machines' can be subdivided into five operations, viz. (i) cutting soap bars into billets, (ii) stamping the billets by machine, (iii) inspecting the stamped tablets, (iv) wrapping the tablets by machine, and (v) packing the wrapped soap into cases. Taking the first operation for example, this can be resolved into following elements: (i) pick up and feed bars from stillages to the billeting table, (ii) operate the billeting machine, and (iii) push aside empty stillages.

In general, the following principles should be followed in breaking down jobs into elements: (i) Each element should have a distinct end point. This is necessary not only for facility of recording the time for the element, but also for identifying it at any time.

(ii) The element should be of as short a duration as can be practically timed. This is because the shorter the element, the more accurately one can judge its pace and secondly it will isolate all extraneous times, e.g., waiting, distractions etc., occurring between elements from the actually necessary elements. It has been found that in practice a suitable range of duration for an element is from .04 minute upwards. Elements smaller than this cannot be accurately timed with a stop watch and if such elements have to be timed, more refined instruments will have to be used. On the other hand elements of too long a duration are also not desirable because they will defeat the purpose of breaking down the job. A suitable higher limit will be about .40 of a minute though this cannot always be adhered to.

(iii) Elements to be classified according to frequency. Elements such as setting up of jobs etc. which occur at a low frequency should be separated from the repetitive elements. This is only for facilitating the determination of sample size for observations.

(iv) Manual work to be separated from machine work: This is necessary because the pace of manual work can vary whereas the rate of machine work can be taken as standardised.

Incidentally this analysis of jobs into elements facilitates the examination of methods or methods study which is the second preliminary for time study.

Methods Study: It is no accident that Time Study and Methods Study (or Time and Motion Study) have been so closely associated. Apart from the benefit of improved methods resulting from Methods Study, it is all too often true that without Methods Study, Time Study is unreliable, because the method of doing the job determines the time to a large extent and if that method is defective or such as can be improved upon by the operative at a later stage, the Time Study results would have been of limited use only. Indeed it can even be a source of misunderstanding if the time values have to be revised after the operative has simplified the method. The situation is very likely to arise especially under an incentive application and has to be guarded against by ensuring that the method of doing the job has been examined, improved if possible and stabilized before taking the time study. A certain amount of time and trouble taken for this purpose are an insurance against troubles at a later stage.

EQUIPMENT FOR TIME STUDY

Stop Watches: For recording time, stop watch is the most commonly used instrument. Three kinds of stop watches are mostly used in Time Study practice: (i) *Decimal Minute Stop Watch*, for continuous as well as fly back system of Time Study (ii) Split Hand Watch: of which the distinct advantage is that recording of the end point of any element becomes very easy due to the stationary hand. Its only disadvantage is that it cannot be used

for 'Fly Back' system of time recording. (iii) *Decimal Hour Stop Watch*, useful when it is necessary to set up standards in terms of hours.

Time Study Forms: It is essential to have a suitable form for recording the times in order to ensure that (i) the times are recorded in a systematic manner and the methods of recording by different Time Study men working in the same organization are identical, (ii) no data has been missed in recording.

There are two typical forms: one used where the elements of the cycle are not strictly repetitive, i.e. either the elements do not occur in the same chronological order from cycle to cycle, or even if they occur in the same order their time values are variable from cycle to cycle and it is necessary to record reasons for such variations. The other form is used for strictly repetitive operations.

Time Study Board: In order to hold both the observation sheet and the watch in the left hand, so that the right hand is free to record the timings, it is necessary to have a light board which should have a clip for holding the observation sheet either at the corner or at the top and also a clamp at the top right corner to hold the stop watch.

OTHER EQUIPMENT:

Wink Counter: It is a small motor-driven device with a disc on which numbers are written. The disc rotates at a speed of 200 r.p.m. The reading of the disc is noted at the end of any element. Thus readings accurate to 0.005 minutes can be obtained. This is, therefore, useful where more accuracy than that obtained by a stop watch is desired.

Motion Picture Camera: Where more accuracy than obtained either with stop watch or wink counter is required, a motion picture camera is used which is designed to film an operation at a constant speed, usually 1000 frames per minute. Apart from providing an accuracy of 0.001 minutes, this film provides a record of actual performance of the operator and is very useful in judging the rating of the operator (i.e. comparing the pace of the operator with a standard pace) by a Time Study expert or a group of experts, at any time convenient to them. If a constant speed camera cannot be obtained, a microchronometer can be placed by the side of the operator, and film taken at any speed. The position of microchronometer at the end of any motion will indicate the time taken by that motion.

Time Recording Machine: This machine incorporates a graduated paper tape moving at a uniform velocity. There is a key which when depressed makes a mark on the printed tape. This machine is useful where elements of shorter interval than can be timed with a stop watch have to be timed or where the elements do not have a very distinct end-point, thus requiring constant visual attention. However, this machine has not been found very popular, due to its inherent defects which are: (a) Only repetitive cycles, not involving any foreign elements can be timed. (b) Speed of tape fluctuates due to fluctuating voltage, resulting in errors in recorded time.

TAKING THE TIME STUDY:

Reading the Stop Watch: There are two methods available for reading the time for each element from a stop watch, these being as described below.

Continuous Timing: In this method, the watch is started at the beginning of the first element of the first cycle and continues to run throughout the study periods. Readings of the timings are taken at the end of each element. Element times are then obtained after the completion of the study by computing differences. This is a widely practised method and has been found to be more readily acceptable to labour

than the 'Snap Back' method decribed below.

Snap Back Method: In this system, the watch is started at the beginning of the first element of the cycle to be timed and its hands are snapped back to zero at the end of every element. Thus the actual time of each element can be obtained directly from the watch, without any need for computing differences as in the method described earlier. The error introduced in this system by the time taken to re-turn the watch to zero after every element, is found by experiments to be infinitesimally small.

Selection of Operator: Under normal conditions this may not be necessary. However, if the persons doing a given job are not all of the same grade of skill in that job, it becomes necessary to select the operator possessing the requisite skill. Such selection should be on the basis of observation by the Time Study man in consultation with the supervisor. It must be added that wherever possible such selection should be avoided in order to prevent unnecessary arguments regarding the objectivity of observations.

Position of Time Study Man: The position of the Time Study observer relative to the operator is very important. The observer should take up such a position that he is able to see everything done by the operator; at the same time he should be neither absolutely in front of the operator or so close to him as to make him feel that somebody is standing over him. Different Time Study men prefer different positions, but the position considered satisfactory by the majority of the skilled Time Study practitioners is by the side of the operator or slightly behind him.

Number of Cycles to be Timed: The number of cycles to be timed will depend on a variety of factors such as the length of cycle, variations of cycle time due to inherent characteristics of the job, lack of skill on the part of operator and the varying conditions under which the job is to be performed. The number of cycles timed should be such as to give a representative sample incorporating all the factors affecting the variations of cycle time. There are inherent variations in any time study. They are caused by differences in method, operator skill, materials, or errors in time measurement. Even if all such variations can be eliminated, still there would be natural variations in the cycle times due to random occurrences, and a certain minimum number of readings have to be taken to allow for all random variations with a certain degree of confidence. The question is, how many readings would be sufficient. This can be easily found from a monograph, prepared by Dr. Gerald Nadler.

Length of Study: It is desirable to spread the number of readings required for any element over more than one occasion, so as to be able to get a representative picture of varying conditions which may occur from one occasion to the other and may not possibly be recorded if the study is taken on one occasion only. Apart from the actual number of readings required, the length of study also depends on the capacity of the observer to concentrate at one time and the latter has been found to be varying but mostly within the range of 1 hour.

A CRITICAL ANALYSIS OF RATING

The actual time which is measured in a time study is not necessarily the normal time, i.e. the time that a normal operator working under normal conditions at a normal pace would take for performing the given element. Even the same operator works at different paces during various parts of the shift and different operators may be working at various paces, and with varying effectiveness. Apart from these natural variations there can also be induced or deliberate variations. For instance, it is our experience that some workers tend to work a little faster while they

are under observation probably because of the anxiety induced by observation. On the other hand there are others who deliberately ease their pace in the belief that by doing so, they will get the benefit of a larger allowed time. In all these cases where variations in pace are normal, induced or deliberate, it will not be fair or accurate to take the actual time as normal.

There is thus a need for eliminating or levelling the variations in actual time observations in order to obtain the normal time. This is the case for 'rating' which is the assessment of speed and effectiveness of the operator by the Time Study Engineer in order to relate it to a normal level. It must be emphasised that 'normal' is not necessarily 'average'.

Rating is an aspect of Time Study which has been criticised very often and the criticism is valid to the extent that there is an element of subjectivity in 'Rating'. While it is unrealistic to deny this subjectivity, it has to be emphasised that it will be equally unrealistic to deny the need for Rating. Accordingly, the best possible solution is to accept rating with its subjectivity and strive to reduce the subjectivity to a minimum. This is the practical approach and the one which has to be accepted until we can find an alternative means of accomplishing the correction for varying pace and effectiveness.

Time Study practitioners have themselves recognised the subjectivity of rating and have taken the following steps to counteract it as far as possible:

(i) The elements should be rated as frequently as possible preferably at every occurrence.

(ii) Observations and rating of the same element should be taken wherever possible by more than one time study engineer.

(iii) As far as practicable, operators doing the job at near normal pace and effectiveness should be studied. This is advantageous in as much as the assessment of rating becomes more difficult as we get away farther from normal in either direction, i.e. towards the sub-normal or to the abnormal.

(iv) Training of the time study engineer in a systematic manner and under expert guidance for a sufficiently long period (at least more than one year) before accepting his observations independently. Like all matters involving judgement (e.g. diagnosis by doctors) training and constant practice are required for refining the judgement.

(v) Refresher courses for time study engineers in order to ensure uniformity and adherence to standards. This can be done by having several jobs (on the floor or as films) each of which is rated by all the time study engineers and then comparing results for purpose of determining variations.

It may, therefore, be concluded that Rating is a necessary part of Time Study and should be practised by trained persons who have a full appreciation of its limitation and their consequent responsibility.

Another fact which may be borne in mind in this connection is that, except under conditions of induced anxiety (which can be dispelled by the Time Study Engineer) or of deliberate slow down, most workers would normally work at near normal rating and, therefore, the tasks of rating and hence its influence in Time Study are less formidable in actual practice than it appears to be in a discussion.

SYSTEMS OF RATING

There are three main systems of Rating in use and each of these is described below:

Subjective Rating: In this system the factors of skill, effort, consistency and working conditions are all taken into consideration by the Time Study Engineer in establishing a concept of normal pace for the particular element.

Thereafter the actual pace of the operator is compared to this normal and expressed on a relative scale. By applying this rating to the actual time, the normalised time can be calculated (= Actual Time × Actual Rating).

Normal Rating

Under the subjective rating system, the rest allowance are added to this normalised time in order to obtain the standard (allowed) time.

Levelling: In this method the factors which constitute the Time Study Engineer's concept of rating are analysed into two separate parts viz., skill or effectiveness and effort or speed and the actual performance of the operator is compared to a graded check list of factors. The details of the system are as follows:

Skill or Effectiveness is shown by differing ability to plan the method of doing the work as influenced by experience and training; also it is shown as ability to perform the work planned, as influenced by dexterity, stature, strength physical conditions and consistency. Effort or speed is shown by the energy applied to influence the output of work. It will also depend on the worker's interest in his work, his attitude, co-operation, as well as energy. Effort may be increased as a result of good labour relations, supervision, and by direct or indirect incentives.

Distinction should be made between effective and non-effective effort as the latter does not influence the output of work.

Conditions of the workplace such as lighting, ventilation, etc. may affect output and an allowance should be made for it. This is treated as a separate allowance, and is not included in the levelling.

Rating or Levelling Factor: When, in the judgement of the Time Study man, an average performance both as to skill or effort is being shown, then a zero levelling factor will be applied. If the levelling factor is minus 7% then 7% will be deducted from the observed time to obtain the levelled time.

Likewise, on above average performance, positive levelled time is greater than the observed time. Levels to be used are:

Effectiveness: Poor —; Poor +; Fair —; Fair +; Average; Good —; Good +; Excellent —; Excellent +; Superb —; Superb +.

Speed has a similar set of grades with one additional grade of "killing" which is the use of so much energy that the pace cannot be maintained by a trained operator for more than a short period of time (one hour). Operators working at "killing" effort ought not to be timed. The Time Study man should wait till the spurt is over before taking figures he used. There are thus 11 grades of skill and effort used which, for convenience may be referred to by the code letters:

P —; P +; F —; F +; A; G —; G +; E —; E +; S —; S +; also K for Killing Effort

Estimating Skill or Effectiveness Level: The following factors should be considered: Familarity with the work (usually shown by correct use of sequence), Hesitation, Errors, Motion and Coordination, Self-Confidence, and Accuracy. The table below shows the degrees of these factors. The "effectiveness" grade to be chosen will be the average of these grades. Note that some of these factors are not appropriate to some of the grades.

Estimating Effort of Speed Level: The following factors should be considered: Attitude to work and foreman, personal attitude, physique, work

energy, and working conditions. The table below shows the degrees of "Speed" appropriate to these factors. The speed grade that is the average of these grades should be chosen.

Allowed Time: As in the Subjective Rating System, here also the allowed (standard) time is obtained by adding the rest allowances to the normalised time derived by levelling.

EFFECTIVENESS

Factors to be identified

GRADE	FAMILIARITY WITH WORK	HESITATION ERRORS	MOTIONS AND CO-ORDINATION	SELF-CONFIDENCE AND ACCURACY
Poor 1	None. Does not know sequence	Hesitates, frequent errors	Clumsy, poor coordination	Slight self-confidence
Fair 2	Slight	Some hesitation	..	Lacks self-confidence
Average 3	Proficient, follows sequence	No hesitation. Rare errors	Slow	Understands tools, has self-confidence. Fair accurancy
Good 4	Above average and correct	No errors	Quick	Correct, reasons methods
Excellent 5	Complete	Precise	Speedy and smooth	Fully self-confident. Little need to check work.
Superb 6	..	..	So quick he is hard to follow	Knows and uses all the short-cuts. Does not need to think

SPEED

Factors to be studied and identified

GRADE	WORK ATTITUDE	PERSONAL ATTITUDE	PHYSIQUE	DISTRACTIONS	WORK METHOD
Poor 1	Kills time	Lazy and disinterested	..	Introduces delays, poor set up	Works slowly
Fair 2	Resents suggestions. Little confidence in foreman	Mental worries	Poor	Does not use best tools	Puts some energy in the job
Average 3	Doubtful of foreman.	Systematic	Holds back best effort.	..	Works steadily
Good 4	Takes interest. Confident in foreman.	Conscientious	..	Well prepared	At best pace for endurance
Excellent 5	Keen	Utmost confidence in supervision	..	As systematic as possible	Cannot maintain effort indefinitely
Superb 6	Excellent	..	Excellent	Never any	Pace only maintained for a matter of hours

Objective Rating: This is probably the most objective system evolved so far and owes its origin to Prof. M E Mundel. In this system also the Rating is a two step procedure, i.e. a judgement of two items, viz., (a) pace and (b) job difficulties. However, as different from the subjective rating procedure, the pace is first judged alone and then the job difficulties are accounted for, in the form of secondary adjustments which are standardised in terms of observable phenomena. The advantage of the system is that thereby judgement of the Time Study Engineer is confined only to the actual speed or pace. The actual step in Objective Rating are as follows: (i) The rating of observed pace against an objective pace standard, which is same for all jobs. In this rating, no attention is paid at this stage to job difficulty and its effect on possible pace, hence a single pace standard may be used instead of a multiplicity of mental concepts. (ii) The use of secondary adjustment, consisting of a percentage increment, added after the application of the numerical appraisal (index) from step (i) has been used to adjust the observed data. This percentage increment is to be taken from experimentally determined tables of the effect of various observable factors that control the exertion required at a given pace. These tables can be set up experimentally, vide sample printed on the following page.

SECONDARY ADJUSTMENTS FOR TIME STUDIES

CATE-GORY NO	DESCRIPTION	REF LETTER	CONDITION	% AD-JUST-MENT
1	Amount of body used	A	Fingers used lossely	0
		B	Wrist and Fingers	1
		C	Elbow, wrist and fingers	2
		D	Arm etc	5
		E	Trunk etc	8
2	Foot Pedals	F	No pedals or one pedal with fulcrum under foot	0
		G	Pedal or pedals with fulcrum outside of foot	5
3	Bimanualness	H	Hands help each other or alternate	0
		G	Hands work simultaneously doing the same on duplicate parts	10
4	Eye-hand coordi-nation*	I	Rough work, mainly feet	0
		J	Moderate vision	2
		K	Constant but not close	4
		L	Watchful, fairly close	7
		M	Within 1/64 inch	10
5	Handling requirements*	N	Can be handled roughly	0
		O	Only gross control	1
		P	Must be controlled, but may be squeezed	2
		Q	Handle carefully	3
		R	Fragile	5
6	Weight or resistance to be over-come	W	½ Lb	2½
			1 Lb.	5
			2 Lbs.	10
			3 ,,	13
			4 ,,	16
			5 ,,	19
			7 ,,	23
			10 ,,	28
			15 ,,	35
			20 ,,	40
			30 ,,	50
			40 ,,	60
			50 ,,	70

*NOTE: These scales could possibly go much higher in some cases.

In the objective rating system, since the normalised time accounts only for normalisation of speed and the secondary adjustments are made for normalising the conditions of work, further additions of allowances to arrive at the Allowed (standard) time will be less than in the other two systems of rating.

A COMPARATIVE EVALUATION OF THE DIFFERENT SYSTEMS OF RATING:

As an illustration of the differences among the three systems, the normalising and calculation of allowed time for an element are shown in the table below:

ESTABLISHING ALLOWED TIME FOR A JOB

OBJECTIVE RATING		SUBJECTIVE RATING		LEVELLING	
OBSERVED TIME.	0.5 Mins	OBSERVED TIME	0.5 Mins	OBSERVED TIME	0.5 Mins
Decide 'Pace'		Decide 'Skill and Effort'		Decide for Effectiveness +7%	
				For Effort—2%	
				Make	
RATING	95%	RATING	105	NET ADDITION 5%	
Gives		Gives		Gives	
NORMALISED TIME	0.475 Mins	NORMALISED TIME	0.525 Mins	LEVELLED TIME	0.525 Mins
Make 'Job Difficulty'		Make		ADD	
SECONDARY ADJUSTMENT	13%	ALLOWANCES	24%	FATIGUE ALLOWANCE	21%
Consists of :—		Consists of :—		Consists of :—	
Amount of Body used		*Compensatory Rest Allowance		*Personal allowance	
*Foot Pedals		*Constant		*Standing	
*Bimanualness		*Standing		*Abnormal Position	
*Eye Hand Co-ordination		*Abnormal Position		*Weight Lifting or use of Force	
*Handling Requirements		*Weight Lifting or Use of Force		*Light Conditions	
*Weight or Resistance to be Overcome		*Light Conditions		*Air Conditions	
*Results in					
ADJUSTED TIME	0.587 Mins	*Air Conditions		*Visual Strain	
Make					
ALLOWANCES	21%	*Visual Strain		*Aural Strain	
Consist of :—		*Aural Strain		Results in	
*Personal		*Mental Strain		STANDARD TIME FOR ELEMENTS	0.636 Mins
*Delay or Contingency		*Monotony		Add Element for	
*Working Conditions		*Tediousness		Delay, Abnormal Working	
*Other Allowances, if any		*Delay or Contingency		Conditions and Other Allowances, if any	
		*Other Allowances, if any		from Production Study	0.014
GIVES		GIVES		GIVES	
ALLOWED TIME	0.65 Mins	ALLOWED TIME	0.65 Mins	ALLOWED TIME	0.65 Mins

If applied with care all the three systems yield comparable results. The Subjective Rating System places an extra responsibility on the Time Study Engineer whereas the Objective Rating system relieves this to a great extent because his responsibility is only to judge the pace. However, Subjective Rating system is easier and simpler to practise and is, therefore, the most widely practised one. In comparison the levelling system seems to suffer from the disadvantages of both Subjective Rating (viz., subjectivity) and Objective Rating (viz., complexity) though to smaller extent. In selecting any particular system one has to take into account the exigencies of the situation and the ultimate purpose of measurement. If, for instance, the performances in a factory are at a low level, complex refinements will be out of place. However it can be concluded that the tendency in future will be more and more towards a more objective system which will continue to be simplified for practical use on a large scale.

SCALES OF RATING

Theoretically speaking one can adopt any scale of rating because it is only a means of relating various observations to each other through a normal or datum level. For example, if one takes 'X' as the datum or normal, then all abnormal rating will be represented X + 'a' where 'a' varies according to the degree of abnormality, and all subnormal ratings will be represented as X—'b' where 'b' varies according to the degree of subnormality. Also, it has been found in practice that the best sustainable level of rating does not exceed normal by more than 1/3 normally. That is, in other words, 'a' does not exceed X/3 normally.

These being the general principles, one has only to substitute a convenient numerical value for X in order to evolve a Rating scale. There are two such scales in common usage and each of them has its advantage. These are described below:

The 60-80 Scale: Here normal is represented by '60' and therefore the maximum rating will be '80' (i.e. 60 + 60/3). Ratings below normal are represented by numbers less than 60.

The advantages of this system are:

(a) It fits in with the SMS/Hr. method of expressing performances because that also has the 60 SMS/Hr. as normal performance.

(b) If one is using a decimal minute stop watch, as is usually the case, the normalised time can be mentally calculated in seconds from the readings of observed time and rating.

$$\frac{\text{Observed time in decimal minutes}}{60} \times \frac{\text{Rating in 60 scale}}{60} \times 60$$ will be equal to normal time in seconds. Since the two 60's cancel we can straightaway calculate the normal time in seconds by multiplying the minutes by the rating.

The 100-133 Scale: In this scale normal is represented by 100 and the maximum limit is, therefore, 133. Below normal ratings are represented by numbers less than 100. This system has the advantage of all decimal systems, viz., simplicity of marshalling figures.

In actual practice, either scale is equally accurate and it is only a matter of one's previous training in one or the other that creates preferences. However, it is quite simple for a Time Study Engineer to switch over from one to the other scale.

CONCLUSION:

Having obtained actual time and rating the conversion of actual time to

normal time is done by applying the relationship: Normal Time =

$$\text{Actual Time} \times \frac{\text{Actual Rating}}{\text{Normal Rating}}$$

REST ALLOWANCE AND STANDARD TIME

COMPOSITION OF REST ALLOWANCE:

So far we have examined the method of computing the normal time required for performing each element in a job. But one cannot expect a worker to work continuously all this rate for any appreciable length of time, even if there are no limitations imposed by machine characteristics. The worker has to avail of certain time for two reasons, viz.:

(a) attending to personal needs away from workplace;

(b) recovering from fatigue caused by work.

In order to account for these factors, we have to add allowances to the normal time. These allowances are known separately as personal allowance and fatigue allowance and collectively as Compensatory Rest (or CR) Allowance. When we add CR Allowance to normal time, the resultant time is known as Standard Time.

The computation of CR allowance has received considerable attention in research work and specifications which are reliable in practice are available for use. In general, personal allowance is a function of the duration and conditions of work, and fatigue allowance is a function of both the type of work and the duration and conditions of work. Hence personal allowance can be expressed as a uniform percentage of the work time for all types of work whereas fatigue allowance has to be varied according to the type of work.

CRANFIELD RECOMMENDATIONS:

As a result of research work done at the Work Study School, Cranfield, UK, a guide for computation of CR allowances has been evolved. But the specifications evolved in Cranfield are for conditions in the UK and are not entirely applicable in India. It is obvious that allowances related to thermal and atmospheric conditions have to be modified substantially.

A MODIFIED GUIDE FOR INDIAN CONDITIONS

A set of guides for computing CR allowances under Indian conditions has been provided by the Productivity Centre of the Ministry of Labour, Government of India, and is reproduced below:

1 STANDING ALLOWANCE:

Males	2%
Females	4%

Standing is known to cause fatigue. Hence this allowance is needed.

2 ABNORMAL POSITION:

Males	7%
Females	7%

In postures, which are unnatural, work is generally more difficult to perform and more energy is used. In allowing for abnormal position, degree of abnormality has to be judged and maximum allowance of 7% for worst case has to be allowed.

3 ARDUOUSNESS, USE OF FORCE, LIFTING, PUSHING, PULLING:

Allowance for lifting of weights under most comfortable positions are shown below. If in addition, an abnormal posture is involved, corresponding allowance is made under the heading "Abnormal Position."

4 LIGHTING:

Males	5%
Females	5%

If it is impossible to raise the general standard of shop lighting to the recom-

mended figures and there is evidence of strain due to inadequate lighting, an amount of up to 5% may be made. For example, if the recommended lighting is 24 ft. candles and the actual is 6, an allowance of 5% should be made.

5 ATMOSPHERIC CONDITIONS—HEAT, HUMIDITY:

When an operator performs a task, changes take place in his body which depend on the nature and arduousness of the task. In general, when work is being done, heat is generated in the body which is lost in the form of perspiration.

The rate at which this heat is lost depends on a number of factors which have not yet been fully investigated. These factors include:

Surrounding air temperature ... dry bulb

Humidity of surroundings ... wet bulb

Rate of air movement at work place

Presence of hot bodies, machines, walls etc.

It is usual to take account of the first three factors in the above list and this can be done simply by Wet Kata Thermometer.

6 ATMOSPHERIC CONDITIONS:

Fumes

Protective Clothing

When an operator is required to work in noxious or unpleasant fumes, an allowance of 5 to 15% may be made according to conditions. If a respirator has to be worn, an allowance of 10% should be made.

7 AURAL STRAIN:

Males	4% Max.
Females	4% Max.

It is generally agreed that a high level of noise occurring at regular intervals does not produce undue strain on operatives working under these conditions. This statement must be taken within normal industrial limits and it is not intended to cover say, the testing of jet engines, sirens and the like. Little is known of the effects of these on human health. But sounds which occur at irregular intervals and at very high intensity cause fatigue, viz., the action of a pneumatic hammer which stops and starts at irregular intervals soon becomes very annoying and eventually "gets on people's nerves". So also does boiler scaling and rivetting.

Examples:

Pneumatic hammer, 5 secs. on, 5 secs. off	4%
Normal testing of auto engines	2%
Overspeed	4%
Press shop, where there is variation in noise level	2%

8 VISUAL STRAIN:

Males	5% Max.
Females	5% Max.

Visual Strain is that strain, caused by close operations, such as watch making, instrument repair, inspection using micrometers or such other instruments, the testing of lamps etc. It is not easy to differentiate between this type of strain and that caused by bad lighting conditions.

Examples:

Testing car head lamps	4%
Inspection micrometer work	3%
Textiles, ring frames, light yarns	2%
dark yarns	4%

9 MENTAL STRAIN:

Males	8% Max.
Females	8% Max.

Mental strain can be caused by a number of factors such as concentration, where an operator may have to remember a long and complicated process.

An example of this nature is the manufacture of automatic ignition coils, in which the operations vary layer by layer throughout the process. A second cause of mental strain is span of attention. This occurs when an operator is required to attend more than one machine. There is always the feeling that when attention is being given to a particular machine, one or more of the remainder may be requiring attention at the same time.

10 MONOTONY:

Males	4% Max.
Females	4% Max.

Monotony is that type of strain caused by the repeated use of mental faculties, such as in mental arithmetic. A clerk whose job is to add up pages of figures or to work out similar problems will quickly become stale unless a complete change of work is available.

11 TEDIOUSNESS:

Males	5% Max.
Females	5% Max.

Tediousness may be defined as the strain caused by the *repeated* use of the physical facilities, such as fingers, hands, arms and legs. Work simplification tends to make operations more tedious for skilled operatives, but has the great advantage that in most cases the simplified work can be done by less skilled operatives. Assembly lines, conveyor belts and similar methods of working can be classified as tedious operations.

CONCLUSION:

Compensatory Rest Allowances are added as a percentage of the normal time for doing each element. Since this can vary for different elements, the computation of standard time has to be done separately for each element and by addition we can obtain the standard time for the operation.

CONTROL CYCLE & PREPARATION OF WORK STANDARDS

Most jobs to be done in a factory consist of a series of operations as described earlier in the example of soap stamping and wrapping. Therefore, each operation is not an isolated event because its performance is dependant on both the operation preceding, and the operation succeeding it. Again the pace of each operation can be either manually or machine controlled. These factors necessitate the balancing of various operations for computing the standard time for the job. This is known as the preparation of the Work Standard.

For the purpose of Work Standards, all jobs can be classified broadly into four different groups:

1. Manually controlled jobs done by individuals.
2. Manually controlled jobs done by teams.
3. Machine controlled jobs done by individuals.
4. Machine controlled jobs done by teams.

We shall examine briefly the preparation of Work Standards for each of the above types.

1 MANUALLY CONTROLLED JOBS DONE BY INDIVIDUALS:

In such jobs the pace is set and controlled by the individual operator himself. His actions are not regulated by the pace of other workmen or by any piece of machinery. An example is a girl bundling a dozen soap tablets in outer wrappers, the soap being supplied from one buffer stock and being removed to another. In such cases the standard for the job can be easily computed by adding up the standard minutes for the various operations involved. Another feature of such jobs is that there is no need for making any separate provision in the standard for 'relieving' which is normally required for attend-

ing to personal needs. This is already provided as personal allowance (part of CR allowance) in the standard and, therefore, the production expected is only to that extent. Therefore if the operator goes out for that period, there is no need for anyone to be substituted.

2 MANUALLY CONTROLLED TEAM JOBS:

In this type of job, groups of operations will be done by various individuals and their pace will be interdependent. For example, in a team of girls filling and packing soap flakes in cartons, the following operations are involved with the SMS as shown alongside for gross of cartons packed.

Note: The SMS values are not actual and are shown only as example.

	SMS/Gross
(i) Form the carton from flat bodies and seal one end	46
(ii) Fill flakes into the cartons	20
(iii) Weigh each carton and adjust if necessary	22
(iv) Seal the other end of carton	22
(v) Wipe carton and pack into woodbox	20
Total	130

The work content for the whole job is 130 SMS per gross of cartons. However, the various operations are not of equal duration and, therefore, it is necessary to determine which one will set the pace. The pace will obviously be set by the operator who takes longest to complete his part of the job.

For example, if we assign one person to each operation the result will be that we will have 5 girls and the first operation (viz. forming cartons and sealing one end) will be the longest and hence the 'control' operation. The time taken by this control operation (viz. 46 SMS|gross) is, therefore, the control cycle or the time required for producing the specified batch, (in this case, 1 gross of packed cartons.)

Now if 46 SMS|Gross is the control cycle it means all the other operators will have to wait for considerable time on account of the first operation being slower than theirs. This enforced waiting will be for a time equal to the difference between the control cycle (46 SMS Gross) and the SMS Gross for their individual operations. This difference (or waiting time) is called the process allowance or PA. It must be emphasised that this is different from other idle time in as much as process allowance is an allowance given to compensate for enforced idleness caused by the nature of the job and not by the operator.

To continue with our example, if the control is 46 SMS/Gross, then the standard time for the job will be number of operators x control cycle, i.e. 5 x 46 SMS|Gross=230 SMS|Gross. This in effect means that even though the total work content for the job is only 130 SMS|Gross we are apparently required to allow 230 SMS Gr. This is on account of the defective allocation of work in the team. It is an example of unbalanced team. If this team is to be balanced, we should obviously allot 2 girls for the first operation and one girl for each of the other 4 operations. In such a balanced team, the control cycle will be 46 2=23 SMS Gross and the allowed time for the whole job will be 23 x 6=138 SMS Gross. This is the correct standard for the job and the PA now is only 8 SMS|Gross. In most cases it will not be possible to balance the team to the fine degree of completely eliminating PA.

In manually controlled team jobs again, it is not necessary to allow any separate relievers because either the team can break off for personal needs all at the same time or create buffers between operations to take care of any individual absence.

3 MACHINE CONTROLLED INDIVIDUAL JOBS:

In all machine controlled jobs the pace is set by the machine and, therefore, the control cycle is to be calculated in terms of machine speeds, machine utilization and rejections.

Since individual jobs are a special case of the general problem of team jobs, the treatment given later for team jobs will be applicable. Incidentally, the treatment will be similar also for jobs which are controlled by 'processes' instead of machines.

4 MACHINE CONTROLLED TEAM JOBS:

The principle here is to calculate the control cycle in the following stages:

(i) Calculate the time required by the machine for producing the given unit of product. (If there is more than one machine operated in series by the team, the one which takes longest will determine the control cycle). Let this time be 'M' minutes per unit of product.

(ii) Extend the above by a machine utilization factor. Machine utilization can be defined as the percentage of time during which the machine is productively employed. This is obtained by deducting from the machine running time, the corresponding percentage of time for which the machine has to be stopped for unavoidable reasons. If the machine utilization is U%, then the extended time, which is the actual time for which the machine will be occupied for producing the unit of product, will be $M \times \frac{100}{U}$

(iii) In many cases all production from the machine is not of acceptable quality. If the percentage rejection is 'r%' of the total output from the machine, then the acceptable production is only (100-r)% of the total output. Therefore, the machine occupied time has to be extended further by a factor equal to $(\frac{100}{100-r})$

Thus the actual control cycle 'C' now will be

$C = M \times U \times \frac{100}{100-r}$ minutes.

This control cycle is used for balancing the team for the operations which are measured by time study. If 'n' persons are required for the balanced team on this basis, the standard (allowed) time for the job will be n x C SMS.

5 INCENTIVE STANDARDS:

Wage incentive schemes are usually operated for compensating above normal (i.e. above 60 SMS/Hr.) performance, the limit being 80 SMS/Hr. (or 133%) performance. In the case of manually controlled jobs this is made possible by the operator working at a rating above normal (i.e. at higher than 60 rating). But in the case of machine controlled jobs the pace is not set by the operator, but by the machine which cannot be speeded up beyond its capacity which has already been taken into account for setting the standard. All the same it is necessary to provide an opportunity for machine controlled operatives also to earn incentives.

This then calls for a provision by which machine controlled operatives can be enabled to work at upto 80 rating. For this purpose the incentive standards for machine controlled jobs are prepared as follows: If there are more than one machine controlled operations in the job, the one which takes longest is selected. Now in this operation there can be parts which are done by the operator while the machine is not running. These are called outside machine work and these will be treated as non-machine controlled work, i.e. standard time will be taken into account. But for those elements

which are carried out while the machine is running (including the attention time) the standard time is to extend them by 80/60 factor. The underlying principle is that thereby we will expect the operator to do 80 SMS of work in every 60 minutes of machine running time. This will enable him to take on more work, if available, than he would have undertaken in a non-incentive standard.

If however, it is not possible to load the operator satisfactorily to 80 rating for the machine running time the process allowance (idle time) should be reduced to a 60 rating (by multiplying that part into 60/80) because it will be fallacious to assume that he can wait at 80 rating. This in effect means that incentive performances (or above 60 SMS/Hr. performances) of machine controlled operators will be only to the extent to which they can take on work during the machine running time at 80 rating.

Another feature to be noted is the definition of work content during machine running time. There are certain definite operations performed by the operator. But in addition he is required to pay attention, in many cases, to the machine while it runs. Since this does not involve any physical work as such, it is difficult to set any time allowance for it directly. In all these cases one should determine whether attention is required at all and if it is required, whether it is to be occasional, intermittent or continuous. Then a practical allowance is 25% of the PA in case of occasional attention, 50% of PA for intermittent attention and obviously 100% of PA for continuous attention. This degree of accuracy is adequate because any difference is significant only to 25% (i.e. 1—60/80) of its magnitude.

In cases where the PA for machine controlled jobs is excessive and cannot be filled in by other work, it will be futile to set standards, especially for incentives. Though the limit beyond which PA should be considered excessive is a matter of individual organization's policy (which in turn will be governed by the number of cases with different magnitudes of PA) a practical limit would be 33% of control cycle. Jobs with PA above this limit should be considered as insufficiently organised in as much as the operator has 1/3 of his time spent in enforced idleness. Such jobs should not be placed on incentives because it will give rise to the anomaly of the operator receiving incentive out of all proportion to his effort and thereby creating unpleasant repercussions in the minds of other men who do not enjoy the advantage of high PA. The remedy should be to find additional work for the operator to fill in his PA.

6 PROVISION FOR 'RELIEF' IN MACHINE CONTROLLED JOBS:

Unlike manually controlled jobs, in machine controlled jobs, if the operator takes his personal allowance for which he has to be away from the work place, the machine will have to be stopped. And once the machine is stopped, the production loss cannot be made up unlike in manual jobs. This feature can be taken into account in the setting of standards in either of two ways:

(a) Lower the machine utilization factor to the extent of the personal allowance of the operator by considering this time as a part of the unavoidable stoppages. This means lowering the utilization by about 3%; or

(b) Provide for separate reliever for such machine operators. Since personal allowance is about 3% of working time, one can relieve about 30 such operators. Therefore, relievers should be allocated, as far as possible, at the rate of one for every 30 machine controlled operators.

Of the two alternatives, the latter is

preferable for three reasons viz., (i) in most cases it is worthwhile obtaining the maximum utilization of machinery, (ii) the operators themselves will understand that there is a provision for relief in their standard and (iii) where the team has a number of persons whose jobs are machine controlled, they need not all take their personal allowance simultaneously as will be necessary in the alternative.

7 USE OF ACTIVITY CHARTS:

An activity chart is a means of showing against a common time scale the progress of several related operations which are assigned to various members of a team. These charts are necessary in the preparation of work standards where the operations are done in series by a team of persons whose work is interdependant or who may join together for the performance of certain of the operations. Such charts are necessary also where operators have to keep pace with a number of facilities like filter-presses, pumps, vessels etc.

By marking off a horizontal line on the time scale for each operator and for each facility and indicating on each line the time taken in proper sequence for each operation, we can obtain the correct control cycle, the optimum number of persons required and hence the standard minutes required for the job. In preparing such activity charts for Incentive standards all manual operations can be reduced by multiplying into 60/80 so that the control cycle obtained will be at 80 rating. Considerations regarding PA and relief will apply as described earlier.

RESEARCH & DEVELOPMENT IN TIME STUDY

Most of the developments through research in Time Study have been aimed at eliminating the subjective element in rating for computation of normal time. As a result of work in this field, certain methods have been successfully evolved. These methods are of comparatively recent origin and though they are practicable they have yet to be developed to a stage where the data can be universally adopted. They are described here more to indicate the trends because except in large organizations in India where data have been collected extensively and reliably, the adoption of any of these systems may be still in the future.

1 STANDARD DATA:

Where time studies have been taken for a fairly long period over a variety of jobs, it is possible to compile standard timings for certain elements which are common to several jobs. This data can then be used for computing the time for any new jobs where the same element occurs. Over a period of time we can thus evolve a catalogue of standard data. Apart from the saving in effort due to avoiding restudy of similar elements, it ensures uniformity of standards. This collection of data will also be useful for estimating and forecasting costs and production schedules.

2 UNIVERSAL STANDARD DATA:

Going one step further, instead of compiling time values for various elements, it is possible to specify time values for each basic motion, and this data can enable us to compute the time for any specified operation. This is what is aimed at in the Universal Standard Data systems like Method-Time-Measurement (MTM), Basic Motion times (BMT), Work Factor etc.

It can be reasonably expected that future developments in Time study will be in this direction and as they are perfected, Time Study will become more scientific. However, at the present moment these systems are yet to be developed to the stage where they can be applied universally. Furthermore, certain questions regarding the accuracy of assuming additivity of basic motion

times and the effect of machine pacing on these data are still receiving the attention of research workers.

3 A COMPARATIVE EVALUATION OF THE DIFFERENT SYSTEMS FOR COMPUTING NORMAL TIME:

Though in theory the refinements to Time Study are all improvements, the selection of a particular method of Time Study in a given organization is dependant on the degree of accuracy required. It is something like say the instruments used for measuring length. For a carpenter building a house, probably a scale marked to the decimals of an inch will be sufficient, but for a machine man turning a part of the lathe, measurements correct to a thousand of an inch may be necessary. Similarly the degree of refinement required in Time Study is very much a matter of the actual pace of work in an organization. In a highly mechanized factory where the operations are also highly repetitive, probably the more refined systems are more appropriate because (a) operator's time is a more valuable commodity and one can, therefore, afford to take the trouble of measuring it accurately and (b) when operations are highly repetitive, they will be also comparatively fewer in number and can, therefore, receive better attention in the way of more accurate measurement. But considering the generality of industry in India, it will be adequate to adopt the Subjective Rating System of Time Study at least until all jobs in a factory have been measured. Thereafter, the organization should attempt to develop Standard Data as far as possible. The third and final stage should be to adopt the Universal Standard Data and this too only if it is worthwhile from the point of view mentioned earlier.

4 CR ALLOWANCES:

The physical, physiological and psychological factors affecting rest allowances have also been subjects of research. Since this can vary considerably from one country to another and even within the same country there is a case for indigenous research which can be undertaken by collaboration between Scientists and Industrial Engineers. The work done in Cranfield Work Study School has been already referred to. Such work will be of use in fields other than Time Study also because the results obtained can be used with advantage in creating the optimum conditions of work.

RECORDING SYSTEM & CALCULATION OF PERFORMANCES

1 PURPOSE OF RECORDING SYSTEM:

The purpose of a Recording System is to collect, verify and process the data regarding input of man-hours and output of products on various jobs so that by applying the appropriate work standards, ratios of $\frac{\text{output}}{\text{input}}$ can be obtained for each job.

For example, if the work standard for a given job is X SMS/unit of output and on a certain day 'P' units of the product were produced with an input of 'Y' man-hours, then the productivity or performance of the workmen on this job would have been

$\frac{PX}{Y}$ SMS/Hr. (Standard minutes per hour)

In order to obtain this ratio, therefore, we must have the following data:

(i) Work standard for each job.

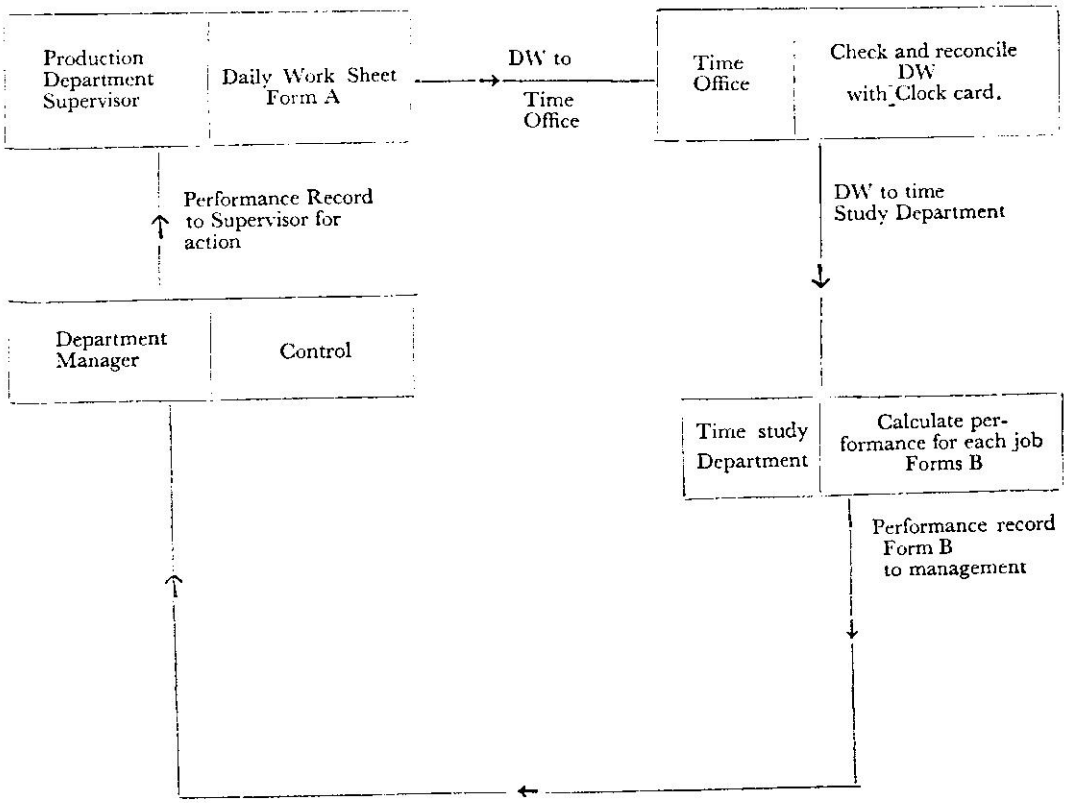
(ii) Production statement for each job.

(iii) Account of man-hours spent on the job.

We have described in the previous sections the derivations of the work standard. In this section the collection of the other data will be described in detail.

2 COLLECTION OF PRODUCTION AND MAN-HOURS DATA:

It is assumed for this discussion that the frequency of calculation of performance will be daily. It can be different according to the type and organization of the work, as will be described later. The recording and flow of information with the appropriate forms required are indicated in the chart and forms below: Thus there is a closed circuit of control effected through the operation of the Recording System.



Form A — Daily Work Sheet: This shows the data regarding production in units on each job and the number of man-hours spent by each of the various operators assigned to the job. These sheets will be prepared by departmental supervisor. The production statement can be checked with physical stocks and the man-hours state are checked at the Time Office where it can be verified whether every tally number who has reported for work has been accounted for on one work sheet or the other. Incidentally this serves as a departmental attendance record also. A convenient form is one wherein the data regarding more than one job can be presented on the same sheet.

Form B — Daily Performance Record: Instead of sending back to each departmental manager a number of

daily work sheets, it will be more useful to prepare a summary wherein the performance of each of a number of teams is shown together with data on production obtained, man-hours spent, time lost etc. This will form a concise control data for use by the departmental manager and supervisors. A separate Daily Performance Record for each supervisor's section is very often convenient.

3 WAITING TIME

Whenever delays are caused due to reasons belond the control of the operators, these should be recovered on the reverse of the Daily Work Sheet and the equivalent man-hours should be deducted from the input of man-hours fo rcalculations of performances. This ensures that the performance of the operators are not adversely affected on account of delays beyond their control. However, if they are on incentive, naturally the waiting time will be paid only at normal rates and not at incentive rates.

4 CLERICAL LABOUR INVOLVED:

The operation of the system described above requires about one clerk for every 400 workers covered on normal production jobs. On maintenance jobs where the number of standards (estimates) involved will be larger this proportion may appear to be inadequate. However, this is compensated by the fact that in such cases performances may not be calculated daily, but only at longer intervals, e.g. weekly. This figure of one clerk for every 400 men is excluding the normal staff in Time Office who can cope with checking and is intended only as a rough guide. It will vary from industry to industry. Furthermore, if incentives are applied the work and hence clerical requirements, will be about 50% more.

MULTIFACTOR MEASUREMENT OF PERFORMANCES

In certain cases where skilled operatives are employed for maximising utilization of machinery and materials including services their performance cannot be adequately represented in terms of physical effort alone. This consideration applies also to other skilled jobs like supervision. Performances in such cases have to be calculated on a Multi-factor basis. All the factors which are considered relevant to the performance of the person should be listed. Since these may be too numerous for manipulation in practice, a selection has to be made from among these on the basis of two consideration viz. (a) extent to which the person can influence the factor and (b) the significance of the factor measured in terms of economics or quality. For instance, in the case of a section supervisor some of the factors which can be taken into account are:— performance of labour assigned to his care, achievement of production targets, utilization of materials goodhousekeeping etc. Having selected the factors, each factor has to be assigned a weightage (in percentages adding up to 100 for all factors) whcih again will be based on the relative economic or quality significance of the factor. Also, for each of the factors certain range of performance starting from a datum level and improving to a target level has to be specified. The ranges on all factors should be placed on one uniform scale so that they can be additive.

Much of the material analysed above is available in different forms in standard text books on the subject of Time and Motion Study. Our only claim to originality is to have attempted to elevate the concepts from the plane of text books to another which has the added dimension of experience, though only limited, in India.

Productivity of an Industrial Office

Jogendra Prasad*

THE study of Productivity of an Industrial Office has not yet received the attention it deserves, principally because an office has been traditionally assumed to be some sort of a clerical place, where a few ill-paid, semi-literate persons take up their pens with difficulty and record in a uniquely illegible manner about materials and papers associated with the work, of which they personally know nothing. A modern industrial office bears no recognizable resemblance to this traditional pattern. An Industrial Office stands strategically at the cross-roads between the Board Room and the Shop Floor; and the efficiency with which it handles communications between these two vital segments of an industrial concern determines in fact the level of its productivity.

This is not all. A still more strategic cross-road, that between the Shop Floor and the whole hinterland of the market on which the life of the concern depends—lies flat across the industrial office.

Probably the whole perspective would become clear, if the office is viewed in the light of its proper functioning: the whole layout has to be planned and the markets both of raw materials and finished products have to be mapped out; costs as also the probable profits tentatively worked out. All this is precisely the function of an Industrial Office.

Once the set-up is complete, its functioning in an orderly, profitable manner has again to be organised by the Office. Additionally, as already hinted, the Office functions in an interpretative manner—interpreting the decisions of the Board Room in terms of investment, personnel, production techniques etc. to the men in charge of the shop floor and communicating upwards the difficulties and problems of the latter on to the Board Room.

Not only are decisions canalised, implemented and interpreted through the office, but the whole inflow and outflow of money concerned with sales and purchases which constitute the life-blood of the Organisation take place through the Office. The papers that pass through the Office are merely a record of the forward and backward flow of money, which help to sustain the concern.

Every business, therefore, whether it be big or small, must have a well-equipped office, operated by trained personnel, who can perform their functions effectively and economically in furtherance of the main objectives of the concern. So far, we have heard of efficiency in output and administration but the pivotal function of an office in the economic life of the country—in its commerce and industry—has not been, for reasons already analysed, sufficiently appreciated. Marginally, probably, the reason for this has been, strangely enough, that an Office is a somewhat inexpensive item in the balance of accounts and the concept of its efficiency has been rather vague and indeterminate.

The way the Industrial Revolution came historically, gave higher priority to the shop floor than to the Office,

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which organised the whole show; and a certain amount of contempt for so-called paper work which was rightly common among the early pioneers, has to some extent persisted.

Later developments have proved conclusively that this conception of 'paper work' has no correspondence to reality. All decisions, from beginning to end, regarding output have to be recorded and the efficiency with which this job is done determines the status and the position of the firm in the market. At the ground level, it may be said that the expense on office work has to be analysed in the same manner as other manufacturing expenses. In fact, both have to be taken together as integral parts of a common concern and subjected to the same test of productivity.

Many soundly conceived policies fail in execution, because top-management is inclined to regard promulgation of policy as its fulfilment. Programmes of budgetary control have often been wrecked, because of lack of a well-defined procedure to gather, group and correlate facts so as to provide an effective tool of management.

There is need of streamlining procedures and systematisation and standardization of office work as much as of other productivity techniques practised on the shop floor. In this context, a 'method study' of office procedures has been worked out in this paper, with particular reference to the following aspects of the problem under consideration : (a) The precise work performed by various departments; (b) persons or groups of persons, identified as performing the functions; (c) the various steps in the processes to be done — that is, their order and timing.

This is a big field of study. This paper only seeks to underline the importance of Procedure Study in the context of the most productive organisation of industrial activity. Procedures are means by which all repetitive business is initiated, carried forward and controlled. It is through forecasting and budgeting procedures that operating plans are developed, through purchasing procedures that materials are obtained. In a manufacturing concern, production-control and scheduling of men, machines and materials are coordinated through procedures. It is through accounting procedures that information required for controlling costs, profits and assets are gathered, summarised and reported. These procedures ensure and enhance the productivity of a concern. Hence procedure is not only an office phenomenon. Its implications are widespread and it plays a vital role in the operations of all departments.

The objectives of this Methods Study may now be elaborated in the context of a firm's Productivity : (1) cutting clerical costs; (2) reducing direct costs by building tighter operating controls; (3) improving customer service; (4) strengthening executive effectiveness; (5) improving policy execution; (6) raising employee morale; (7) compensating for shortage of clerical labour and equipment. This list of objectives of methods study is only illustrative and is not necessarily consecutive.

Each one of these objectives could be elaborated to indicate how they keep the entire business machinery in gear, but to do so will mean a more comprehensive paper than this article, which deals only with fundamentals, supported by essential details.

The "utility-cost" concept, however, needs special mention, because of fear of redundancy of staff as a consequence of rationalisation of office procedure. This fear is really groundless. Mechanisation of bank accounts in India led to staff redundancy in the ledger section, but the surplus staff was fruitfully redeployed in other branches of

activity — control of branch accounts, internal audit etc. In a manufacturing company, surplus office staff of the general section can be usefully utilised, for example, in inventory control.

We may now mention briefly the few details, to complete the picture of this analysis : A procedure analyst records the entire procedure process in a chart, which indicates the flow of work and operations performed. An intra-departmental procedure chart indicates the complete picture of the various steps taken for performance of a particular activity. The area of activity under examination must therefore be precisely delineated. A typical procedure study form is given below.

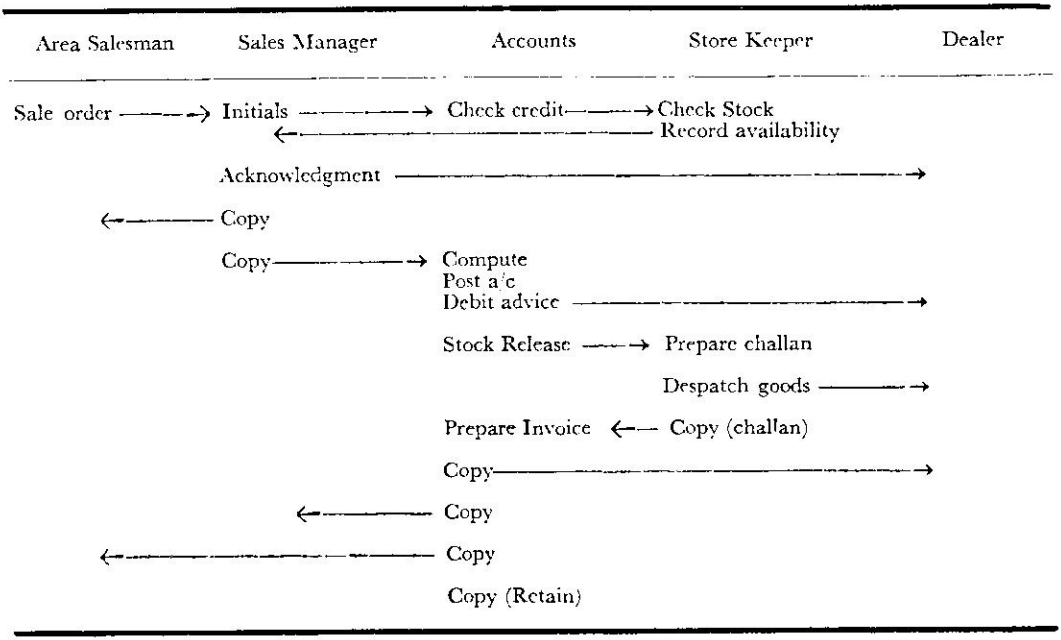
Procedure Survey

The chart on page 63 gives a picture of the different stages and various steps taken to comply with an order sent by the salesman of a particular area. It is obvious that the procedure is defective and some operations can certainly be eliminated. Some of the improvements may well be availability of upto-date information about stock position, and credit-worthiness of dealers with the Sales Manager so that he may immediately on receipt of the sale order instrust despatch of goods. The chart reproduced on the following page, is a representation of the various steps involved in processing an order sent by a salesman, but it gives no clear idea of the really productive operations in the process. It is essential to separate general productive operations from others which only look 'productive' but are really not so, so that the procedure analyst may develop his recommendations. The skeleton flow chart, given on page 64, would be a help in this connection.

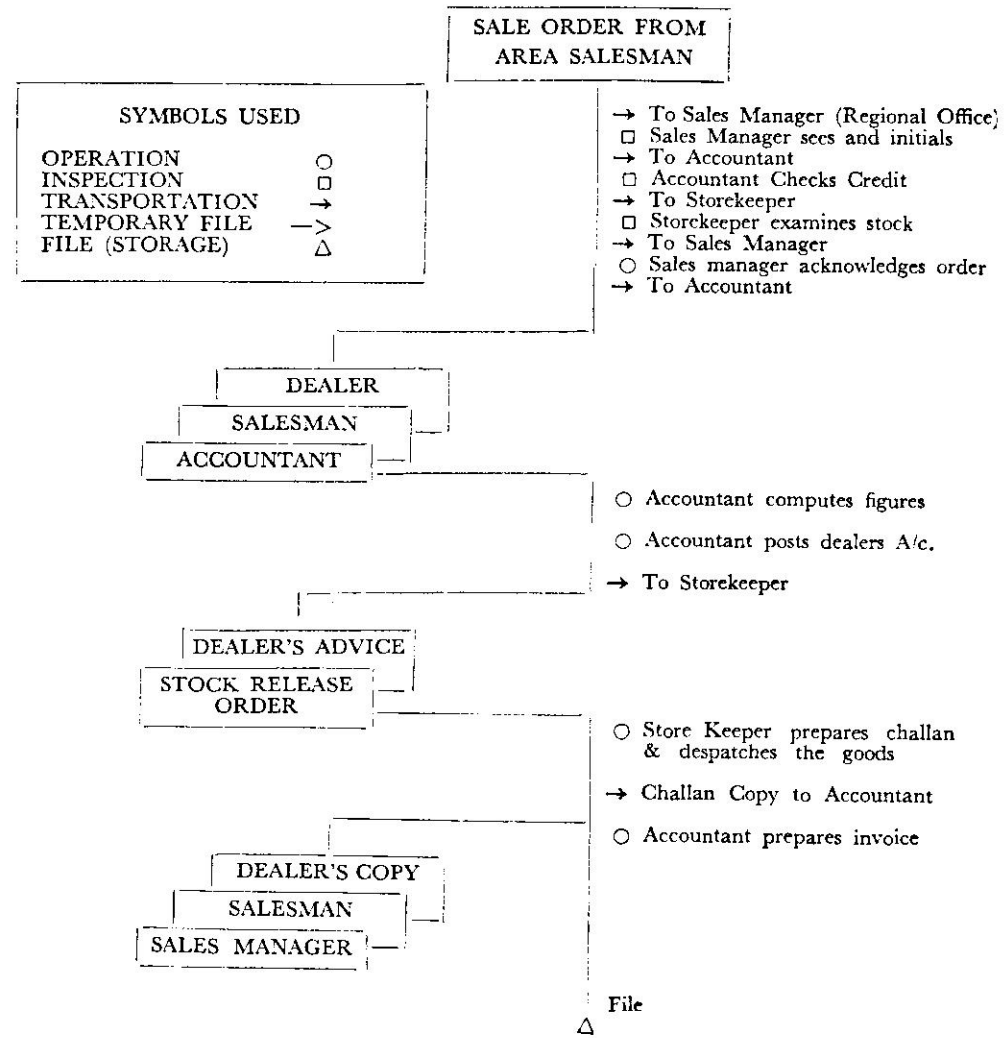
Subject : Processing of orders sent by salesmen.

Objectives : (*a*) to reduce time required of salesmen in preparing order forms.

(*b*) to reduce clerical expense involved in processing orders and invoicing

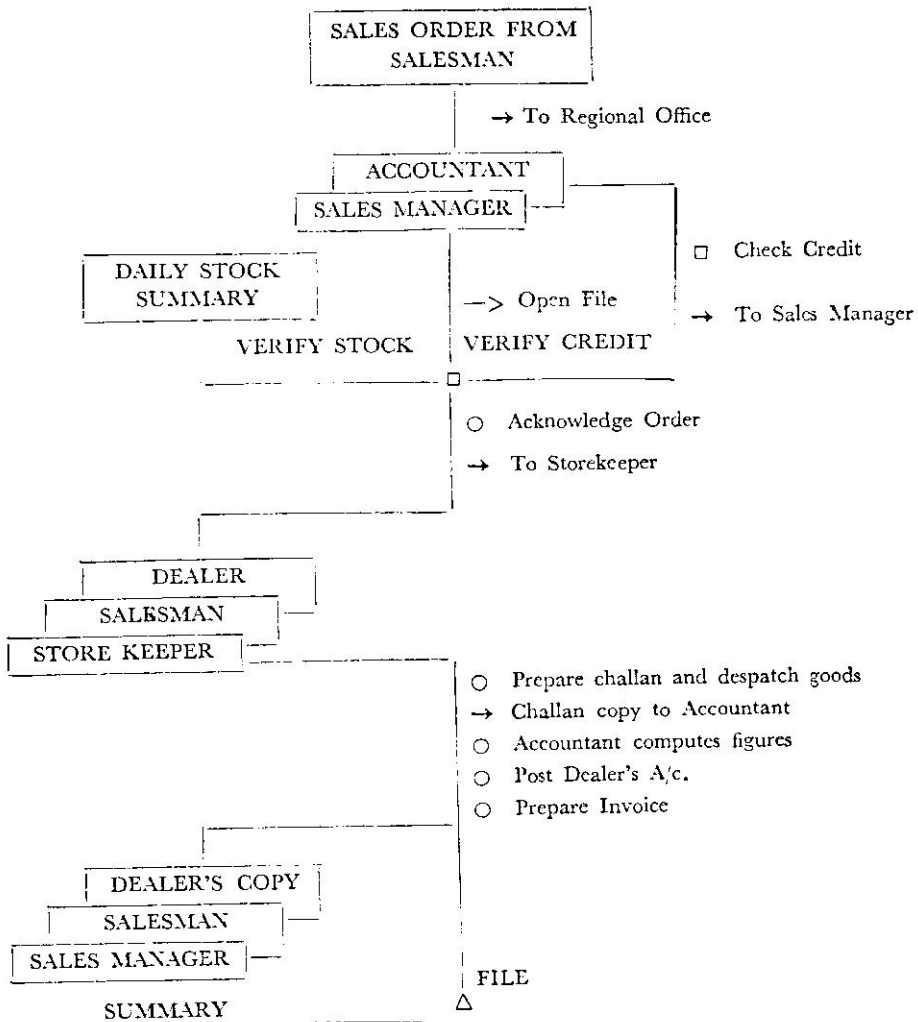


OLD METHOD



OPERATION	○	5
INSPECTION	□	3
TRANSPORTATION	→	7
TEMPORARY FILE	—>	—
FILE	△	1
TOTAL		16

IMPROVED METHOD



SUMMARY

		New Method	Old Method	Saving	In-crease
Operations ..	○	5	5	—	
Inspection ..	□	2	3	1	
Transportation ..	→	3	7	4	
Open File ..	—>	1	—		1
File (Storage) ..	△	1	1	—	
Total ..		12	16	5	1

Saving in time from the improved method, shown on preceding page, would be considerable. It is almost reduced to three-fourths, and this in itself would contribute a good deal to office efficiency.

A statement of philosophy would, of course, be out of place in an analysis of this character. But it is broadly true that people are generally averse to change; and this is so particularly with office staff. It is probably so because of routine. It is not their fault. Circumstances and traditions have led to this rather unhealthy attitude of mind, which saps enthusiasm. Probably it could be remedied by periodically changing personnel between sections or departments. Change in attitude of mind is essential, because even the best procedure would fail to yield results due to staff's lack of enthusiasm to make a success of it.

A procedure analyst has always to be on the look out to find new and more efficient ways of doing things. He has almost to weave a new pattern of design. Simplification of operations, change in timings of various operations to avoid delay, redesigning of forms to highlight relevant information would be some of the ways of bringing about "Efficiency" in office work.

The opportunity of work combination has also to be fully explored. Two or three operations could be conveniently combined in one. Wages-slip and pay roll may well be conveniently combined in one; statement of account may be a bye-product of the entries made in personal ledgers; sales journal may be eliminated by filing invoices chronologically and so on.

In industrialised countries, where labour is expensive, mechanisation of routine, and work-aids have almost revolutionalised the entire office procedure. We in India cannot afford to close our minds to these developments. Unlike the work done on shop-floor, where reduction in costs of production is one of the main objectives to be pursued, office work has to be done speedily to provide useful information to management, even at a higher cost. The high costs involved in such office operations may well lead to considerable saving in so many spheres. Figures relating to sales, costs and inventories are some of the items, which an effective management might take into consideration for formulating sound policies.

The various ways by which "efficiency" could be brought about without much cost have been broadly indicated above. Incidentally we need to examine the implications of mechanisation of office work and its scope in our country.

Mechanisation of office systems means much more than merely purchasing some equipment, like franking machine, duplicators etc. It involves complete overhauling of some operations, and the entire system has to be studied and standardized to justify full utilisation of equipment and trained personnel. Installation, for example, of a small book-keeping machine demands that relevant posting data is available in time, and ledgers are standardized.

Standardization and streamlining are a pre-requisite to mechanisation. An expensive equipment may have to remain idle, if for instance, the machine operator does not get particulars of payments received, because of the cash book being held up at other points in the system.

In industrialised countries, where giant electronic equipment handles most of the office-work, the entire procedure and routine have had to be standardized even to the minutest detail, so as to avoid bottlenecks. This mentality brings some rigidity in its train. But the rigidity is not unbusiness-like because a thorough "Work-

Study" precedes it, taking into consideration all the aspects of business, with allowances for departures from routine.

It is true that "Work-Study" came first to shop-floor and then to office, but its importance in office is much more than is generally recognised. In a modern society, all social, political and economic activities centre round an efficient office, and that is why office inefficiency may affect efficient working of an industry. Government regulations regarding maintenance of books of account, pertaining to provident fund, income-tax, health insurance etc. may handicap streamlining of procedures in a factory.

It is true that "Work-study" in office has its own complexities; and it is difficult to say where it begins and where it ends. In India, management is generally slow in taking decisions, often acting on little more than instinct. Work-study of office operations connected with decision-making could yield good dividends to management, if properly organised. The results achieved would bring about a change in attitudes of office people who would begin to think and act efficiently.

ADVERTISEMENTS FOR THE JOURNAL

(NPC Announcement 3)

Uptil now, NPC has not, as a matter of policy, accepted any advertisements. Due, however, to persistent demand from manufacturers to secure space for their advertisements in this Journal, it has been decided to welcome advertisements. The objective of this Journal is to stimulate thinking towards a more efficient functioning of industries and to contribute, in every possible way, to the most productive utilisation of men, machines and materials, so that industry should gain, and the country, prosper. It is, therefore, expected that industrialists would find this Journal an appropriate and profitable vehicle for their advertisements. Opinions about this Journal have been printed overleaf. The Journal has a wide circulation to all industries of the country, including large-scale, medium and small-scale, in the public as well as the private sector. It reaches industrialists, managers, technicians, trade unions, business organisations, libraries and numerous other persons, interested in the development of industry. It also goes to members of Parliament, ministers and senior officers of Central and State governments, foreign embassies and productivity organisations, the world over.

The schedule of advertisement rates has been moderately fixed as follows:

	Full Page	Half Page	Quarter Page
	Rs.	Rs.	Rs.
Six Issues	550	300	175
Three Issues	300	175	100
Single Issue	125	65	35

Rates for special positions :

Third title cover 10% extra (full page or half page only)
Back title cover 50% extra (full page only)
(Additional 25% for each additional colour)

Since NPC works for Industrial Productivity, it expects a favourable response in terms of advertisements from industry.

SUBSCRIPTION FOR THE JOURNAL

(NPC Announcement 4)

Subscription for the Journal, fixed at a **nominal** rate of Rs. 9.00 (inclusive of postage) for a whole year, is likely to be revised to Rs. 12.00, with effect from 31 March 1960, upto which date, orders will be booked at the old rate of Rs. 9.00. Orders, received after 31 March 1960, will be at the revised rate. Copies of the First and Second issues of the Journal have been exhausted. New subscribers will get 6 copies, beginning with the current (Third) issue.

NPC VALUES READER'S OPINION ABOUT THIS JOURNAL

(NPC Announcement 5)

It is essential to get the reaction of the persons, who read the NPC Journal, PRODUCTIVITY. Hence this request to answer the following questions :

I How do you like this Journal? What is your over-all impression?
II Which do you consider the best items, so far published?
III Which are the items, which, in your opinion, need not be included?
IV Any suggestions for improving the quality of this Journal?

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ABOUT THIS JOURNAL

"... I have glanced at the two copies of your Journal and understand its very great importance in the setting of new India...."

Gunnar Myrdal
Director, Twentieth Century Fund Research Project, South East Asia.

"... The very thought-provoking articles punctuated with apt cartoons make this journal a Must for any management library...."

R P Billimoria
Chief Personnel Manager, TISCO, Jamshedpur.

"... It should be produced in many Indian languages, so that a large number of persons who are not proficient in English may be able to read the contents...."

S C Sen
Principal, Delhi Polytechnic.

"... This journal is perhaps the only one of its kind in India devoted exclusively to the dissemination of information about productivity, its philosophy, techniques and benefits ... Both in respect of the quality of the contents and the get-up, printing and layout, the first two issues maintain a good standard. The case study of a productivity project undertaken in an aluminium concern in India, contained in the second issue, illustrates what productivity improvement means in terms of higher output, lower cost and fuller utilisation of materials ...

This is an excellent publication, embellished as it is with telling cartoons and suggestive quotations...."

The Commerce, Bombay,
16 January 1960.

"... The essentially meaningful simplicity that the Journal has succeeded in maintaining throughout, in respect of its presentation and language...."

B B Lal
Allahabad University.

"... 'Productivity' is Par Excellence and stimulating...."

V Krishnamurthi
Director, SICS, Calcutta.

"... I found all the articles of interest...."

M Skinner
Secretary, National Joint Advisory Council for Electricity, London.

"... This most interesting publication...."

U K Trade Commission, Bombay.