PRODUCTIVITY

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APY '70

APY
MESSAGES
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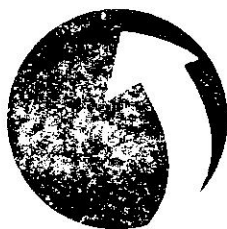
Asian Productivity Year—1970

On 1 January 1970, India along with 13 other Member-countries of the Asian Productivity Organization launched the Asian Productivity Year.

The objectives of APY-1970 are —

(i) To achieve greater prosperity through productivity;

(ii) To increase productivity consciousness; and

(iii) To intensify productvity action for accelerating economic growth.

Sponsored by APO, the theme of APY is "Quality Reliability" and the principal motto, **Prosperity Through Productivity.**

India is a Founder-Member of the APO, and has taken a leading part in its activities in the last decade. To make the APY a success, NPC has chalked out plans to intensify its activities by providing an increasing number of productivity services in the field by way of training, consultancy, seminars, etc., including programmes for workers and trade union officials. A massive programme for Supervisory Development is proposed to be launched in April 1970.

On the occasion of the launching of APY-1970, we are proud to announce that the President of India, Sri V.V. Giri, who has been a great champion of productivity, has become the Patron of APY-1970. We have also received from him, and the Vice-President, the Prime Minister, and other distinguished personalities from all walks of life inspiring messages for the success of APY. These messages have been reproduced in the following pages for the benefit of our readers. We feel greatly encouraged by the enthusiastic support accorded by them to the APY Programmes of the NPC, and this will certainly go a long way in ensuring their success.

We propose to bring out a Special Issue of this Journal, on the APY, later in the year; in this connection the reader's earnest attention is invited to the leading article in this issue on Productivity in Asia. As the long-term objective of the APY is acceleration of the rate of economic growth in the countries of Asia, research scholars all over the world working on the Asian Economy are particularly invited to make their work available for publication in the NPC Productivity Journal. — EDITOR

V. V. Giri

Patron of APY '70

Tremendous Scope For Increasing Productivity

— Giri

Text of Message

I am happy to note that the National Productivity Council is going to observe **1970** as Asian Productivity Year.

A nation's level of prosperity is linked with the level of productivity. This calls for a massive drive towards productivity rise on a continuing basis, and distribution of the gains of such a productivity rise on a fair and equitable basis. Production and consumption are really a continuous process in sustaining the nation's economy on a progressive basis. Unless people have adequate incentives and purchasing power, unless the size of the national market

expands,—not much headway can be made in raising productivity or expanding production.

As a person who had been closely involved with the trade union movement in the country for more than four decades, I feel a satisfactory method of sharing the gains of productivity is of utmost importance for the proper evolution of the productivity movement not only in India but in other countries as well. I understand NPC in India has already done the basic work in this field, but a lot more remains to be done. Whereas institutional approach to this problem is important,—what is even more important, however, is the whole-hearted acceptance of this theme by management and labour at all levels.

I should like to congratulate the NPC for the excellent work it has done in popularising its services in India and abroad. I have no doubt India with her varied and meaningful experiences towards economic development on such an extensive front, will provide all assistance that is practicable for developing the productivity programmes in other countries, whenever required. There is tremendous scope for increasing productivity in the country not only in industry and agriculture, but at all levels of organized activities, not excluding Government departments. I am confident that the various programmes planned by NPC for 1970, including the much-needed intensive drive for QUALITY RELIABILITY, and introduction of the scheme for self-development by Supervisors, will contribute substantially towards more effective functioning of enterprises, and thus help them to raise the level of national productivity.

In the ultimate analysis, the strength of APO depends upon the strength of the national productivity organizations of the member countries, and, in this context, I hope India succeeds in providing a good example.

V. V. GIRI
President of India
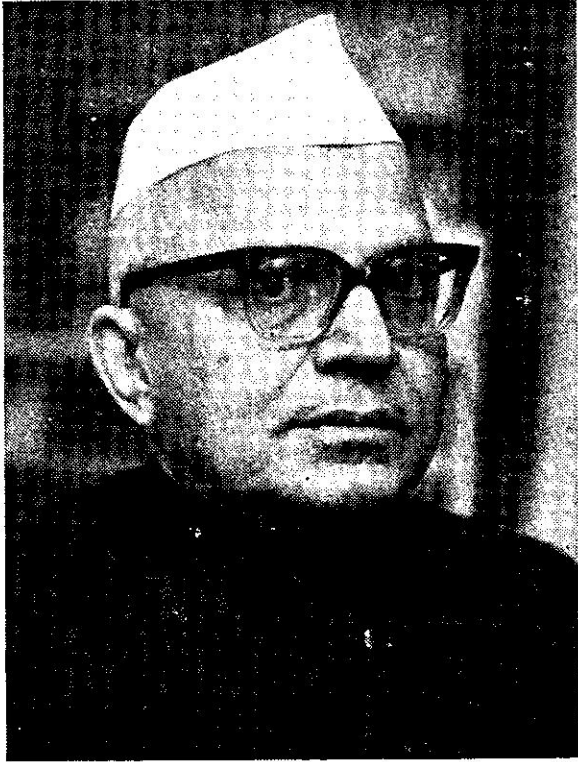
Stress on QR Commendable, Says Vice-President

G. S. Pathak

Text of Message

I understand that Asian Productivity Year will be celebrated in India during 1970.

It is gratifying to learn that the productivity services rendered within our country by the National productivity Council have registered 200 per cent rise and received high compliments from all quarters. The proposal of the National Productivity Council to implement some of the programmes of the Asian Productivity Organization including the intensive drive for Quality and Reliability during the ensuing Asian Productivity Year is commendable. There is no doubt that the endeavours of the National Productivity Council will contribute substantially towards the more effective functioning of enterprises in our country.

I wish the celebration of the Asian Productivity Year all success. —G. S. PATHAK, Vice-President of India.

Prime Minister Calls For Regional Cooperation

Indira Gandhi

India believes in regional co-operation. In the present-day world, it is essential for the countries of Asia, which are emerging from centuries-old social stagnation and which are developing their economies and harnessing their creative talents to work together to help one another with their skills and resources.

Modernisation means the improvement of productivity in agriculture, in industry, in public utility services, and in administration. In our own country, the National Productivity Council has done much to propagate the concept and methods of productivity. The productivity movement helps national progress and fosters international co-operation.

I am glad to know that the Asian Productivity Organization, Tokyo, of which India is a founder-member, has decided to celebrate Asian Productivity Year in 1970. My good wishes to the programme. I hope that during the Year the countries of Asia will move forward towards greater productivity, and also further strengthen the patterns of economic co-operation among themselves.

INDIRA GANDHI
Prime Minister of India

M. Hidayatullah

Chief Justice Hails NPC's Efforts

―――― Text of Message ――――

The National Productivity Council is celebrating this year as the Asian Productivity Year. Already the efforts of the Council have led to a steep rise in production since it has been realised that our prosperity is tied to production and more production. The Council must be congratulated for dragging industry out of the sluggishness into which it had fallen. The celebration of the Productivity Year will give further impetus to the producers, and I send my very best wishes for the continued success of the Council.

― M. HIDAYATULLAH, Chief Justice, Supreme Court of India.

G. S. Dhillon

Vast Scope for Productivity in a Developing Economy

I am glad to know that the Year 1970 will be celebrated as Asian Productivity Year. Productivity services occupy a place of great importance in any industrial and technological society, much so in a developing economy. If the tempo of development is to be maintained and achievements consolidated, it is necessary that productivity should tend to increase. But the quantity produced should not be at the cost of quality. It has been noticed that in the name of achieving targets quality is often neglected. Productivity does not stand quantitative increase alone. I am glad to note that during APY-1970, the emphasis will be on quality and reliability. I wish your celebrations every success.

G. S. Dhillon
Speaker, Lok Sabha

X

Productivity-based Planning for Economic Growth

The celebration of Productivity Year is nothing new in India because in 1966, under the expert organization of the National Productivity Council, an IPY (Indian Productivity Year) Programme had been successfully implemented over the entire area of the country, which resulted in the higher consciousness of productivity and the more enthusiastic application of various productivity techniques. I am very pleased to take note of an announcement made in early 1969 by Mr. N.N. Wanchoo, Chairman of the NPC and APO Director for India, that the demand for the Council's field services had shown a steep rise during the year 1968-69, as also the reference made by the Hon. Fakhruddin Ali Ahmed, Union Minister for Industry and President of NPC in July 1969, to the 60 per cent utilization of NPC Consultants' available time in field-work. These prove that the promotion of productivity drive in India had achieved a real significant result which in turn would certainly contribute towards a significant breakthrough in its economic developmental efforts.

I am particularly gratified that even India which celebrated its Productivity Year four years back, has, as a founder-member of the Asian Productivity Organization, still decided to celebrate the Asian Productivity Year (APY) in 1970 with

Ichiro Oshikawa

a massive programme as announced by the NPC three months back. in the spirit of mutual cooperation for higher productivity of the whole Asian region. I am sure that with its rich experience in the past, India must be able to set a good example in organizing the APY campaign, for the benefit of other member-countries of APO to achieve the best possible result.

The national movement for higher productivity in Asia was initiated in Japan nearly 15 years ago, and I had the privilege to be associated with the movement right from the start. Basing on my experience in the past, it has been my strong belief that in productivity promotion, knowledge and theory alone would not be able to achieve much; the more important are the techniques and approaches of their application to the actual situation of individual countries. Therefore, in our productivity campaign, we should strive for the development of suitable techniques without which one can never hope to yield any significant result.

In the past years, APO has bent itself to preach the idea of establishing a proper linkage between productivity and economic growth. This means that the policy-makers at the national or local levels should always have the concept of productivity in mind in planning for economic growth; otherwise, the planning could never be expected to be wholesome and sound, and its implementation may hit bottlenecks.

For the promotion of a regional productivity drive, it is essential that suitable measures should be devised to bring closer the productivity levels of various countries in the same region. Economic development can be accelerated through collective efforts among countries of the same region and no country can be really prosperous if the surrounding countries are poverty-stricken and backward. It is therefore essential for the more advanced or developed countries to extend a helping hand to their neighbours. This could be more easily achieved through such multilateral arrangements as those being promoted by APO and other international organizations having a similar purpose.

— **ICHIRO OSHIKAWA,** Secretary-General,
Asian Productivity Organization

Prosperity Through Productivity

Asia Needs Massive Doses of Productivity, Says F. A. Ahmed

Fakhruddin Ali Ahmed

Text of Message

As President of the National Productivity Council of India, it gives me great pleasure to send a message of congratulations to the APO on its decision to observe 1970 as the Asian Productivity Year. This is going to be a significant event because Asia today needs massive doses of productivity to improve the people's living standards and to accelerate her economic development in order to make up the great leeway in the Productivity Race with the developed countries. If APO has to achieve the objectives it has set before itself, it must organise its productivity programmes with due regard to the realities of the situation.

The countries of Asia, commanding only 20% of the world's area, have to sustain 55% of the world's population. We have in Asia, at the moment, a population of around 2000 million out of a total world population of nearly 3,600 million; and what is more burdensome, out of an annual global increase of about 65 million, 40 million occurs in Asia. Our primary requirement, therefore, is to produce food and organise work for large masses of people increasing at a comparatively fast rate; hence our Productivity Programmes must be powerfully oriented towards the achievement of these imperatives of social policy. In fact, we have no alternative; and we can make Productivity acceptable to the Governments and the Peoples of Asia, if it answers their primary needs.

I am sure, the APO will push up its programmes along these lines during the Asian Productivity Year. —FAKHRUDDIN ALI AHMED, President, National Productivity Council.

A Significant Event, Says NPC Chairman

As Chairman of the National Productivity Council of India, I regard it as a significant event in the history of the NPC that it will soon participate in a wider productivity drive from January 1970 when the Asian Productivity Year commences. This will provide us with an opportunity for intensifying our programmes and we shall have the pleasure and the privilege of collaborating with fellow-members of the APO in participating in the productivity drive throughout the Region.

I would like to take this opportunity of announcing our special contribution to the Asian Productivity Year through the launching in April 1970 of our Scheme of Supervisory Development. In fact, this has been the weakest link, so far, in the Productivity Chain, both in quantitative as also in qualitative terms; for, however grandiose our ideas of productivity may be, they can only be effectively transmitted to the shop-floor through the frontline supervisory staff. With rapid industrial development throughout the countries of Asia, we have, in the first instance, too few properly trained supervisors who can give concrete shape to our productivity ideas. The NPC Scheme of National Certificate Examination in Supervision, to be launched as a part of the APY, is intended to remedy both these defects, so that as the years go by, a sufficient number of well-tested supervisors become available for the many positions that are going to emerge at the frontline supervisory level, as a result of the massive programmes of industrial development.

While this will be our major contribution to APY, all the other programmes that we have worked out during the past 12 years, will also receive a fresh impetus due to the general intensification of our own activities as also due to the generous help we shall receive from fellow-members, and from the APO itself. I, therefore, welcome the inauguration of the APY in January 1970, and wish it all success. —N. N. WANCHOO, Chairman, National Productivity Council of India.

N. N. Wanchoo

India to Launch Special Programmes During APY

By
Fakhruddin Ali Ahmed
President, NPC

THE ASIAN PRODUCTIVITY ORGANIZATION, in collaboration with its 14 member-countries, including India, is celebrating 1970 as Asian Productivity Year, popularly known as APY-1970. The chief objective of this year-long effort is not merely to generate productivity consciousness in the general sense of the term, but also to lay the foundations of generating effective productivity services in the field for accelerating the economic growth of Asian countries.

Broadly speaking, the density of population of the APO member-countries is nearly three times the average density in the world. Besides, there is a big productivity gap between Asia and the rest of the world. Even if we go by population alone, the situation is alarming, for our populations are increasing at an alarmingly high rate. In fact, out of an annual world population increase of 65 million, 40 million occurs in Asia, 11 million in America, 8 million in Africa, and only 3 million in Europe. At the same time, the developed countries, with a comparatively slow rate of population growth, possess centuries of accumulated capital, technical know-how, and industrial skills, which we, in the developing countries, lack at the present moment. Very obviously, we require massive doses of productivity to make life tolerable for our people. The leeway to be made up in Asia is, therefore, enormous, and I hope that APY-1970 will lead to a significant breakthrough in the field of productivity, which, in turn, will usher

in an era of rapid economic development in the APO member-countries. The slogan for APY-1970 has, therefore, been appropriately chosen as "Prosperity through Productivity".

India is a founder-member of the Asian Productivity Organization, and will take a leading part in the celebration of APY-1970. Realising the universal need for improving the quality of goods and services in the Asian countries, the theme chosen for concentrated attention during APY-1970 is "Quality Reliability". In accordance with this theme, the National Productivity Council, which will organize APY-1970 celebrations in India, will sponsor special programmes on this theme through its 47 Local Productivity Councils spread all over the country. In this, it will also enlist the active cooperation of various other organisations and institutions devoted to the cause of productivity. Our most important contribution during APY-1970 will, however, be the launching of a Supervisory Development Scheme with the help of the Local Productivity Councils and enterprise-level officers—a scheme which, we feel, has by far the greatest potential for serving the cause of national productivity. Besides, a variety of promotional and field activities for different levels of management, including workers and students, will be organised throughout the country.

We, in the National Producitvity Council, are proud that we have received the patronage of the President of India, the blessings of the Vice-President, and the Prime Minister of India, and inspiring messages from distinguished personalities from all walks of life for the success of APY in India. We are greatly encouraged by the moral support we have thus received in our gigantic task, and this will go a long way in making our programmes during APY-1970 more meaningful and fruitful.

The productivity movement in India has made a spectacular breakthrough in recent years. During 1968-69, a 97 per cent rise was registered over the rate of utilisation of the specialists of the National Productivity Council prior to the India Productivity Year-1966. This year the rise is even steeper—in the region of 123 per cent. The National Productivity Council has increased its subsidies and discounts for various promotional services, and yet has enhanced its revenue from the field services by 320 per cent during the year 1968-69.

During the past two years, it has put in massive efforts for working out the details, systematising and consolidating the contents and methodologies of each and every training course, and preparing training manuals for most. It has also developed the methodology for cost-oriented consultancy work for enterprise-level services. We have found, from our experience, that the surest way of quantitative expansion of the productivity services in the field is to ensure their qualitative excellence, with the requisite professional depth and implementational bias. The quasi-intellectual academic generalities and platitudes on productivity should be avoided as these tend to alienate other practical working people without producing any appreciable impact in the actual field.

Having consolidated its programmes at the national level, the National Productivity Council has now started popularising its services internationally as well. It is gratifying to note that the "built in" professional depth and the success of field services of the National Productivity Council has made a deep impression on the member-countries of the Asian Productivity Organization. In the Ninth Workshop Meeting of the Asian Productivity Organization, the APO Secretary-General hailed our achievements and called the National Productivity Council a model institution for all other Asian countries to follow. The services of the Executive Director were requisitioned last year by the APO for drawing up the plans and programmes for APY-1970, and preparing a central brochure for APY-1970, titled "Productivity Means Prosperity". The National Economic Council of the Philippines and the Central Training Organ of the Government of UAR also took advantage of his services for strengthening their organisations and field services, and in December 1969 he has finished another consultancy assignment abroad covering Thailand, the Philippines, Hong Kong, and Japan. Recently, a training programme on Materials Management was conducted exclusively for the Afghan nationals. A one-year industrial engineering course and a series of top management seminars are scheduled to be conducted in Cairo from February 1970. An application training programme on the Development of Small Industries exclusively for Brazil nationals is scheduled to be held in May 1970. It is hoped that as years go by, the high quality of India's productivity services would have an increasing measure of success both at home and abroad. In this connection, I cannot restrain myself from making a special mention of Sri N. N. Wanchoo, Chairman of the Governing Body of the National Produc-

tivity Council, for having provided inspiration and strength in the process of attainment of considerable improvement of productivity services in India and abroad.

Despite having achieved this significant progress, we cannot afford to be complacent. A lot more remains to be done and to be accomplished in popularising productivity services, so that the people in India can lead tolerable lives. Let us dedicate ourselves towards the fulfilment of this basic objective during APY-1970.

We in India are vitally interested in the success of the APO for the overall success of the pattern of regional cooperation, upon which the future of Asia depends so much. It is only by promoting the development of an in-built strength in each national organisation under expert professional direction that the APO will be able to create self-perpetuating productivity potentials in different regions. Let me earnestly hope that with the celebration of APY-1970, APO will become a more powerful source of inspiration to the national organisations for developing their productivity services, ensuring the requisite professional depth and qualitative excellence in the process. Let us also hope that APY-1970 will mark the beginning of a new era of fostering a pattern of intensive regional cooperation in the field of economic and social development for promoting productivity in Asia. With these words, I wish all success to the National Productivity Council of India, the Asian Productivity Organization, and all its member-countries in making APY-1970 a truly fruitful effort.—*Talk Broadcast from AIR. New Delhi, on December 27, 1969.*

Management efficiency is a wishful dream without competent supervisors in your team.

Productivity Promotion is Main Task of Modern Management

MESSAGES FROM GOVERNORS AND CHIEF MINISTERS OF STATES

In any sphere of socio-economic activity, Productivity is a *MUST* and during APY-1970, efforts will be made in India and other Member-countries of the Asian Productivity Organization to organise programmes for the dissemination of the philosophy, concepts, and techniques of productivity.

With the goodwill and support of so many distinguished personalities—Governors and Chief Ministers of States, and several great men in many walks of national life, whose Messages of Blessings for the APY are printed in the pages that follow—we are confident that the observance of 1970 as Asian Productivity Year would encourage mutual and fruitful collaboration among the Asian countries. Productivity knows no national barriers and Asian countries should collaborate with each offer in promoting productivity in the region.   —Editor

Assam

May Accelerate Economic Growth

I am glad to learn that India will be celebrating Asian Productivity Year in 1970. Increased productivity will accelerate economic growth, bring greater prosperity, and improve the living standards of the people. More and yet more production is the answer to most of the problems of our country. I am sure our National Productivity Council will take appropriate action to implement the programmes, and achieve the objectives set for Apy-1970.

I send my best wishes for the success of Asian Productivity year-1970.
    —B. K. NEHRU, **Governor of Assam and Nagaland.**

Role of N. P. C. Praised

The National Productivity Council has been playing an important role in promoting the growth of productivity consciousness throughout the country in the different sectors of our national economy. The Council and its Regional Directorates as well as the Local Productivity Councils have been carrying on regular training programmes designed to familiarise the young executives from industry and business with the basic areas of management and also with the various productivity techniques. It has also undertaken consultancy work in a number of public and private sector undertakings demonstrating over the years the applied values of the use of productivity techniques. The Productivity Services rendered within the country by the Council have registered a 200% rise for which it deserves to be highly complimented.

I am happy to learn that India along with thirteen other member-countries of the Asian Productivity Organization will be celebrating the Asian Productivity Year in 1970. The object of celebrating the Year obviously is to generate productivity action in the developing countries with a view to promoting the level of production in the different fields of economy through the application of productivity techniques and consultancy services.

On the occasion of launching of the Asian Productivity Year-1970, I convey my greetings and good wishes to all those members of the National Productivity Council whose initiative and services have largely helped in bringing about a breakthrough in the field of production. I wish the celebration programme all success. — **B.P. CHALIHA. Chief Minister of Assam.**

Gujarat

Crucial to India's Development

I am glad to know that the Government of India is celebrating Asian Productivity Year in 1970.

I need hardly mention that increase in productivity is crucial to India's economic development. I compliment the National Productivity Council for the useful services rendered by it and convey my good wishes on the occasion.
— SHRIMAN NARAYAN, Governor of Gujarat.

Of Tremendous Significance

I am indeed privileged to be associated with this movement of productivity, which in my opinion has a critical impact on the developing economies. In that context the celebration of Asian Productivity Year in 1970 assumes tremendous significance.

In an effort to industrialise an underdeveloped country, it is not unnatural that the considerations of productivity will be temporarily suspended before a stage has been reached in which consciousness with regard to the productivity of each unit of production not only becomes relevant, but almost the cornerstone of further progress. The fact that such a stage has been reached in our economy needs no elaboration. It is, therefore, significant that there is already a great deal of productivity consciousness in our country, and the Asian Productivity Organization is indeed to be thanked for aiming at cohesion of developing countries in this crucial effort.

The era when it really did not matter at what cost we produce and at what price we sell is indeed over not only because we have to produce at a cost at which we can sell, but also because of the growing competitiveness of the export market. It is also to be emphasized that an exercise in productivity is essentially an exercise in quality because wastage and quality cannot co-exist for any length of time.

In my view it should be our effort to disseminate and imbibe the contemporary practices to optimise productivity. The National Productivity Council as well as the Asian Productivity Organization are doing stupendous work in this field. Even locally in our State, Productivity organizations are doing commendable work not only in spreading productivity consciousness but in inculcating modern practices generative of higher productivity.

I therefore wish this movement great success, and I hope that this year of 1970 which is being celebrated as an Asian Productivity Year will not only heighten consciousness of productivity, but bring the developing nations closer in the common effort to reduce costs of which time is a critical factor. I also hope there will be intercommunication in the fields of technology, as at higher levels of production productivity cannot be divorced from process technology.
—**HITENDRA DESAI, Chief Minister of Gujarat.**

Haryana

Effective Use of Resources Urged

I am glad to know that India would be observing the year 1970 as the Asian Productivity Year.

In many countries, particularly the under-developed ones, productivity consciousness is of comparatively recent origin. It is now being progressively realised that without increased production both industrial and agricultural

there cannot be any substantial economic growth. Increased productivity can only be achieved through a more effective utilisation of all our resources, human and material. Utilisation of waste products in an industry, for example, cuts down the cost of production. Fuller utilisation of managerial talent—of which there is a shortage in India—is most important. Ineffective supervision and management are often the main causes of poor productivity. Some of the labour inefficiency that one notices in India can be directly attributed to managerial inefficiency and is due to the supervisor's inability to instil among workers the importance of removing all impediments to increased productivity. The absence of standardisation of products and quality control are other defects mostly noticeable in a developing economy.

I hope the Asian Productivity Year will succeed in pinpointing the role of productivity in national economic growth, and in making people more conscious of the importance of the adoption of new techniques for improving productivity. — **B. N. CHAKRAVARTY, Governor of Haryana.**

Key to Self-Reliance

I am happy to learn that our country, along with 13 other member-countries of the Asian Productivity Organization, would observe 1970 as Productivity Year. I send my very best wishes for its success.

Increased production in the agricultural and industrial fields holds the key to the achievement of self-reliance for the country. We have to increase the output of whatever we produce, improve its quality and gradually reduce the cost. For this we have to disseminate the knowledge of improved methods of production up to the lowest production unit, up to the common farmer, and up to every worker.

The services rendered by the National Productivity Council in raising productivity standards are highly commendable. I hope during the Asian Productivity Year greater efforts will be made to create productivity consciousness and the urge for attaining higher production levels.

Let us make the Asian Productivity Year-1970, one of progress, strength, and prosperity. — **BANSI LAL., Chief Minister of Haryana.**

Jammu & Kashmir

Good Headway Made ...

The Government of India as a member of the Asian Productivity Organization will be observing 1970 as Asian Productivity Year. The Productivity Movement has made good headway in our country, though much has yet to be done to make people productivity-conscious in the various fields of industry, agriculture, and trade. The observance of APY should help considerably in educating our people in the applied values of the uses of productivity techniques, and I have no doubt that vigorous efforts will be made in all States in this direction.

I have pleasure in conveying my good wishes for the success of the APY celebrations. — **G.M. SADIQ, Chief Minister of Jammu and Kashmir.**

Kerala

Yeoman Service to Country

I am delighted to learn that the year 1970 will be observed as Asian Productivity Year. It has come to be generally accepted that productivity is the crying need of the hour, and it is significant that the principal motto of the Asian Productivity Year is **PROSPERITY THROUGH PRODUCTIVITY.** The National Productivity Council has been rendering yeoman service to the cause of productivity. I am sure that signs of prosperity as a result of its functioning are in evidence in many sectors of activity in India. I fervently hope that the observance of 1970 as the Asian Productivity Year will make meaningful contributions to the cause of productivity and make people more productivity conscious. — **C. ACHUTHA MENON, Chief Minister of Kerala.**

Maharashtra

Quality and Reliability

It gives me great pleasure to convey my very best wishes to the Ministry of Industrial Development and Company Affairs and the National Productivity Council on the occasion of the launching of Asian Productivity Year which our country will celebrate in 1970.

The Council has been rendering very useful service in the cause of our industrial development, and one may say that it has succeeded to a large extent in increasing productivity consciousness in India. Its proposals to launch an intensive drive for quality and reliability, and to implement its new self-study scheme for supervisors, will, I am sure, be widely welcomed.

I wish every success to the activities of the National Productivity Council and the Asian Productivity Year celebrations. —S. P. KOTVAL, **Governor of Maharashtra.**

" An Uphill Task"

The developing countries of Asia have embarked upon the stupendous task of economic development and improving the living standards of the Asian people. This is an uphill task and for this purpose it is necessary that the human and material resources available to the Asian countries are utilised in the best possible manner. It is only through the application of modern productivity techniques that productivity in all sectors of the economy, including agriculture and industry, can be improved. Efforts have to be made to eliminate waste of resources in all forms and to devise ways and means whereby, with a relatively small increase in input, a comparatively larger output is obtained.

The decision to observe the year 1970 as the Asian Productivity Year indicates the keen desire of the Asian countries for mutual collaboration to promote productivity through special integrated Regional Programmes to be undertaken during the year. Through its Regional Directorates and the Local Productivity Councils, the National Productivity Council, New Delhi, has already achieved good results in fostering productivity consciousness in different sectors of the economy all over the country. I am sure that APY-1970 will enable the developing Asian countries including India to achieve greater prosperity through productivity. I wish APY-'70 all success. —V.P. NAIK, **Chief Minister of Maharashtra.**

Madhya Pradesh

A Laudable Endeavour

It gives me pleasure to know that India, which is a member of the Asian Productivity Organisation, will be celebrating the launching of the Asian Productivity Year in 1970, and that during APY 1970, the National Productivity Council, which renders productivity services within India, will organise a drive for Quality and Reliability as also a self-study scheme for the Supervisors of enterprises to enable them to function more effectively and contribute substantially to the raising of national productivity. The endeavour is laudable and I have no doubt

that it will put India on the high road to productivity and prosperity.

I have great pleasure in sending my best wishes for the success of the venture.—**K.C. Reddy, Governor of Madhya Pradesh.**

Real Breakthrough Possible

It is heartening to note that India will be celebrating the Asian Productivity Year in 1970 in a meaningful manner.

The importance of improving productivity is too self-evident to need any elaboration. I am of the considered view that India can achieve a real breakthrough in the sphere of industrialisation and also most of the industries can become flourishing ones with greater induction of new and improved techniques of productivity. Cost and Quality Control along with management of marketing are of paramount significance to an industry, and improvement in these spheres alone can give our industrial effort the much-needed shot in the arm.

There is no doubt that the Government of India has done a commendable job in this field, but still much more remains to be done to tackle the problem of improving productivity to an appreciable extent.

I wish the 'Year' celebrations all success and assure you of the utmost cooperation of the Government of Madhya Pradesh in this direction.—**SHYAMA CHARAN SHUKLA, Chief Minister of Madhya Pradesh.**

Mysore

Growing Interest Among People

I send my warmest good wishes on the occasion of the launching of the Asian Productivity Year, which India is celebrating shortly. I am aware of the solid role of our Government in the Asian Productivity Organisaton, to step up the needed base in the productivity sphere. The N.P.C. has done well to register a rise of 200% by way of its productivity services. The people have begun to feel the absolute necessity to go according to productivity lines, in order to build our economy. I am sure the Asian Productivity Year-1970 will be made full use of by the National Productivity Council and get the benefit by that endeavour. I wish the Asian Productivity Year all success.—**VEERENDRA PATIL, Chief Minister of Mysore.**

Usefulness of Training Courses

I am glad to know that the Government of India, as a Member of the Asian Productivity Organisation, will observe the Asian Productivity Year in 1970 along with 12 other member countries of the Asian Productivity Organisation.

Increased production in both Agricultural and Industrial fields has engaged the attention of all the countries in order to raise the economic standards of the people. The Government of India has started the National Productivity Council to assist and train individuals and industrial concerns in modern techniques of increased production. Elaborate programmes of training of supervisory staff, etc., are being undertaken by the Council. It is necessary that all concerned should avail themselves of the facilities thus provided in order to achieve maximum results with minimum expenditure.

As part of the programme, the India Productivity Year was celebrated in 1966 and experience was gained in the methods of achieving greater success in productivity programmes. The observance in 1970 of the Asian Productivity Year will no doubt similarly go a long way in making tangible progress in the productivity campaigns. I hope that all concerned will fully cooperate in the programmes of the Asian Productivity Year-1970.—**S. S. ANSARI, Governor of Orissa.**

Apt Emphasis on QR

I am glad to know that the National Productivity Council is observing the Asian Productivity Year (1970). The importance of the concept of productivity cannot be overestimated, and it is heartening to note that in India the Council has been able to make the business community productivity-conscious. I am sure the training, consultancy, and research services provided by the National Productivity Council will help in increasing production further, and thus contribute materially to general prosperity. I hope the efforts of the N.P.C. will help in streamlining production and in improving management techniques in the weaker sections of industry. In this context, it is apt that during APY-70 the National Productivity Council should lay the much-needed emphasis on Quality and Reliability.

I wish every success to the important mission undertaken by the National Productivity Council. — **D. C. PAVATE, Governor of Punjab.**

I am very glad to know that India is shortly celebrating 1970 as the Asian Productivity Year. India is indeed an important member of the Asian Productivity Organisation and our National Productivity Council, which represents India in the Asian Organisation, has made a proud name for itself by registering a substantial rise in production and by bringing about considerable growth of productivity consciousness in different sectors of our national economy. I wish all success to the celebrations which, I am sure, will further the cause of all round productivity in this country. —**GURNAM SINGH, Chief Minister of Punjab.**

Rajasthan

Consultancy Services

I am glad to learn that the Asian Productivity Year will be celebrated in India in 1970 along with other countries of the region.

The National Productivity Council is rendering commendable service for the growth of productivity consciousness in different sectors of the nation's economy. The Council has also undertaken consultancy work in a number of public and private sector undertakings, and has demonstrated the applied values of the use of various productivity techniques. I hope the celebration of the Asian Productivity Year will help increase productivity in the region, and improve the living standards of the Asian people.

I wish the sponsors all success in their aims. —**Hukam Singh, Governor of Rajasthan.**

'Generate Quality Consciousness'

I am happy to learn that the year 1970 is being celebrated as Asian Productivity Year by the Asian Productivity Organisation in all the member-countries.

The principal motto of APY celebrations will be 'Prosperity through Productivity, and the theme will be 'Quality Reliability'. Consciousness towards Productivity and quality consciousness are very necessary for acceleration of economic growth. I am sure the programmes organised during the APY celebrations will help in developing this consciousness towards productivity and quality.

The National Productivity Council of India has played a very useful role in this sphere since its inception in 1958. It is heartening to note that the NPC proposes to launch new productivity schemes in a big way as part of APY celebrations.

I send my best wishes for the success of the APY programmes and of the schemes undertaken by NPC in this context.—**MOHANLAL SUKHADIA, Chief Minister of Rajasthan.**

Laudable Objective, Says Army Chief

I am happy to send this Message to the National Productivity Council on the occasion of its launching the Asian Productivity Year-1970.

Yours is, indeed, an eminently laudable objective of improving the standard of your people through increased productivity; the theme 'Quality Reliability' is a very practical and useful one.

Despite the allround progress the country has made since 1947, the layman is justified in questioning whether what has been achieved is really sufficient and whether we could have achieved more. Your efforts, I feel, will help answer these questions, firstly by showing him what is being done through the communications media that you will utilise and the seminars and symposiums which you will organise, and secondly, by your stressing on quality reliability, you will prove that what is produced is of a high enough quality which the man in the street can confidently purchase and make use of.

You have my very best wishes for all success.

—Gen. SHFJ MANEKSHAW
Chief of the Army Staff

Tamil Nadu

Bid to Improve Living Standards

I am glad to know that Asian Productivity Year will be celebrated in India in 1970. This event will, I am sure, be hailed by all member countries of the Asian Productivity Organization inasmuch as it is aimed at an increase of productivity in the region and improvement of living standards of the Asian people.

Our objectives are to achieve greater prosperity through productivity; to increase consciousness of productivity; and to intensify productivity action for accelerating economic growth. The National Productivity Council in India has a good record of service, acclaimed both at home and abroad. Particular mention must be made of the Productivity Survey and Implementation Service which assists an enterprise in making the most out of its invesment in the productive resources. It is in the fitness of things that the National Productivity Council should propose to implement during the Asian Productivity Year-1970, some important programmes towards intensive drive for Quality and Reliability, and its new self-study scheme for supervisors.

I wish the celebrations every success and express the hope that the observance of the Asian Productivity Year will greatly assist us in raising the level of national productivity.—**UJJAL SINGH, Governor of Tamil Nadu.**

Another Milestone . . .

I am happy indeed to know that under the auspices of the Asian Productivity Organisation, the year 1970 will be observed as Asian Productivity Year and that the National Productivity Council has resolved to launch an intensive drive for Quality and Reliability.

In an economy like ours, still struggling to find ideological way out, the task of agro-industrial production has to be undertaken on a national footing and considerations of ownership—by private or public sectors—should not be allowed to hamper the cause of progress. Professional skill and hard work alone will boost up the forces of production and bring up the desired result. The National Productivity Councils have been rendering commendable service for augmentation and standardisation of production in the country, and it is gratifying to learn that they have intensified their field of activity during the APY-1970. I am sure the proposed drive will be another milestone in our march to plenty and prosperity, and I wish the same every success.—**B. Gopala Reddi, Governor of Uttar Pradesh.**

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Need at all Levels

I am glad to learn that we will celebrate the Asian Productivity Year shortly. We have indeed been deeply conscious in the recent past of the need to step up productivity at all levels, and the National and Local Productivity Councils in India have been organising programmes and projects towards this end. We have already observed our National Productivity Year 1966. Hundreds of industrial establishments all over the country participated in the programme, and a happy augury was the very large-scale participation of labour, which distinctly showed us that productivity consciousness was ramifying into all sections of our industrial society. In this context, therefore, it is particularly welcome that we are celebrating the Asian Productivity Year fashioned around the theme of Quality Reliability. Time and again, the need for stepping up production in all spheres has been underlined, but the importance of quality and reliability in delivery cannot be over-emphasised so far as the specific but vital field of exports at least is concerned. One hopes that the theme of the celebration will be brought home to all productive sections of our population—be it labour,

NAVAL CHIEF LAUDS NPC

I send my greetings and good wishes to the National Productivity Council (NPC) on the occasion of the launching of Asian Productivity Year-1970.

The National Productivity Council since its establishment in 1958 has attained a position of distinction in providing techno-managerial coverage to those critical areas which impede productivity in an enterprise. Because of the efforts of NPC there has been a considerable growth of productivity consciousness all over the country in the different sectors of the nation's economy. I am very happy to note that during APY-70, NPC proposes to launch the much-needed intensive drive for Quality and Reliability.

I wish the NPC and all member-countries of the Asian Productivity Organisation all success in their efforts to increase productivity in the region so as to improve the living standards of the Asian people.—Admiral A.K.CHATTERJI, Chief of the Naval Staff, Naval Headquarters, New Delhi.

management, supervisory levels or governmental administration. One also hopes that the celebration of the Asian Productivity Year will have a definite and responsive impact on the agricultural community in India as well as on all levels of Government, so that the country as a whole can put in its very best in the cause of productivity. — **C. B. GUPTA, Chief Minister of Uttar Pradesh.**

Delhi

Of Benefit to All

Productivity is the key to progress. Higher productivity benefits everyone—the Employers and Employees alike, apart from increasing the national income. The National Productivity Council has played a positive role by training the personnel in various fields, by introducing new methods of achieving economy, and by demonstrating the value of modern productivity techniques.

I am glad that the Asian Productivity Year is being observed in 1970 in

India as well as in 13 other Member-countries. I am sure the National Productivity Council will render still more useful service to the Nation.

The National Productivity Council has my best wishes for the 1970 Productivity year.—**A. N. JHA, Lieutenant-Governor of Delhi.**

Himachal Pradesh

Quest for Prosperity

I am greatly pleased to learn that India will be celebrating Asian Productivity Year in 1970.

The motto of the year, that is "Prosperity Through Productivity", and the theme "Quality Reliability", represent universal needs specially of the developing countries like India.

The National Productivity Council deserves all praise for its remarkable work in organising productivity services and for creating productivity consciousness all over the country.

I am quite sure the Council's efforts would go a long way in ushering in an era of prosperity in our country.

I wish Asian Productivity Year and the National Productivity Council all success. — **Y.S. PARMAR, Chief Minister of Himachal Pradesh**

'A Big Enterprise in India's Management Education'
VKRV RAO ON NPC PROGRAMMES

I have great pleasure in sending my warm good wishes to the Asian Productivity Organisation, of which India is a member, on the occasion of Asian Productivity Year-1970.

India's economic development plans, in which her people have invested so much of their resources, will succeed only with the application of modern technological know-how to her agriculture and industry. This demands not only capital and technical know-how, but also ways and means of maximising productivity per unit of either labour or capital employed in the enterprises.

To improve productivity, national and continental, is an essential part of modern management. Industrial engineering is a swiftly growing field and covers many integrated systems that draw upon specialised knowledge and skills

from mathematical, physical and social sciences along with principles and methods of engineering analysis and design. Our National Productivity has to concentrate on those aspects of these fields as are of immediate relevance to our socio-economic conditions. These include work study and measurement, the application of MTM and work factor, materials handling, estimating and costing, product engineering, production planning and production control, selection and training of supervisory personnel, communication processes, and so on. Collectively, these are even more important than they are taken separately, since they constitute the essential tools of managerial processes for decision-making and controlling an enterprise.

The National Productivity Council of India and its State Units have already rendered invaluable service to Indian industry through their techno-managerial activities. Perhaps their most impressive contribution is in their executive development programme. As an organised form of in-service education and training for practising managers, these programmes cover a wide range of general and functional areas of management and are organised extensively throughout India. The programmes represent a big enterprise in India's Management Education today.

Increasingly we move from National to Continental productivity; and the Asian Productivity Year is a timely reminder that in modern productivity there are no national barriers. In Productivity as in Health, the countries of Asia are members one of another. We have to work together in know-how and enterprise, to share our expertise and our experience so that it will benefit our collective millions for today and tomorrow.—**V. K. R. V. RAO, Education Minister, Government of India.**

Good Opportunity for Interchange
of Productivity Ideas

It is a very happy augury that the Asian Productivity Organization (APO), which was established in May 1961, has undertaken to organise the Asian Productivity Year in 1970.

During a decade of its existence, the Asian Productivity Organization has been firmly established as an international organisation devoted to the economic development of Asian countries. Fourteen countries are now the members of APO. The activities of APO have inspired great consciousness about productivity and its benefits among the developing countries. Productivity consciousness is essential to accelerate economic growth and increase the competitive strength of a developing economy.

The Asian Productivity Year 1970 will undoubtedly contribute to the introduction of new techniques for achieving productivity, quality control and reliability of the products. There can be no two opinions that these are the essential pre-requisites for sound development and industrialisation.

Asian Productivity Year being the joint effort of member countries will provide a good opportunity for interchange of ideas and studies in the field of productivity. This will also enable the introduction of techniques and methods whose efficacy and usefulness have been well established.

If the Asian Productivity Year-1970 succeeds in bringing about proper consciousness about productivity, quality and reliability in the developing countries of Asia, the Year will be remembered in history as one of great significance in the industrialisation of this part of the world.

I wish the Year all success. — **R. VENKATARAMAN, Member, Planning Commission.**

A Landmark in Asia's History, Says P.S. Lokanathan

I am happy to learn that the Asian Productivity Organisation has decided to observe 1970 as Productivity Year in Asia. It may be recalled that the National Productivity Year was observed in India in 1966 and it was inaugurated by Mr. Lal Bahadur Shastri, then Prime Minister of India, in an impressive ceremony.

Productivity efforts do not start and end in a particular year. They are continuous but it is good that once in ten years or so, there is great concentration of efforts in major activities alongside an attempt to spread the productivity movement in all sectors of the economy. Thus the productivity year will contribute to the development of productivity, both in depth and width.

Asian Productivity Year is thus a landmark in the history of the Asian Productivity Organisation. The National Productivity Council has played a notable part both in the establishment of APO and in helping the APO to formulate and implement its productivity programmes in all Asian countries which are members of APO. It is therefore not surprising that the NPC should participate in a big way in making APY a success and in arranging to celebrate the APY in India in a most fruitful way.

It is not necessary for me to speak of the splendid achievement of NPC since it was established in 1958. I had the honour and privilege of being its Chairman since its foundation and have had the satisfaction of contributing in a small way to its development. Through its regional offices and through its Local Productivity Councils, NPC has undertaken a large number of training programmes of different types, and latterly has entered the field of Consultancy Services. Among the training programmes special mention has to be made of the Super-

visory Development Programme, its Executive Development Programmes, and the programmes for Training of Trainers. The response from industry has been most gratifying as may be judged from the number of participants in each of the training programmes. The P. S. I. S., that is, Productivity Survey and Implementation Service, has been particularly useful to industry, because through it the weak areas of an enterprise could be identified and steps taken to improve the operating efficiency through specific recommendations. In the field of Executive and Management Development also, the NPC has made a distinct contribution and also cooperated with the management organisations to strengthen the Management Development programme. A new and important service has been added to its activities through the Fuel Efficiency Service since 1964 which has become most useful and popular. Since 1966, some work has also been done in the field of Agricultural Productivity.

Today productivity is no longer a matter of propaganda and publicity. In the initial stages, it was necessary to do much publicity work because the productivity consciousness did not exist. Since the last few years, productivity has become a built-in idea in all industries; it has become part of the daily operations of every enterprise. On this occasion, it is only right that I should pay a tribute to Mr. Manubhai Shah, the first President of the NPC and its successive Presidents, Chairmen and Directors. I cannot end this brief message without adding a tribute to the Secretary-General of APO, Mr. Oshikawa, whose contribution to the growth of APO cannot be overestimated. —**P. S. LOKANATHAN, Ex-Chairman, National Productivity Council.**

Productivity Techniques as Crucial to Economic Growth as Investment
—HVR Iengar

As a former Chairman of the National Productivity Council of India, I am particularly gratified to learn that the Asian Productivity Year will be celebrated in 1970.

The importance of the occasion arises from two factors. The first is that the celebration will take place simultaneously in a number of countries in Asia. From time to time there have been suggestions that there should be closer cooperation in the economic field between countries in Asia, and indeed, some ambitious proposals for regional cooperation have been adumbrated. Several major difficulties have to be overcome before such projects can come to fruition. In the meanwhile, every effort that involves coordinated economic drive in Asian countries is to be encouraged.

In the earlier years of planning in India, there was too great a tendency to think that what mattered for economic growth was investment. Economic

models that were drawn up postulated rates of growth on the basis of an input-output ratio. It has been learnt as a result of painful experience that economic growth depends not merely on capital investment, although this is very important, but on a whole variety of human factors which have an effect on the maximum utilisation of the investment. The questions that arise, such as proper physical planning, the management of men, financial controls, and the rest, are matters which come within the purview of National Productivity Councils. It is now being realised more and more clearly that the value of the techniques that are being proclaimed by the National Productivity Council is as crucial to economic growth as investment itself.

I wish all success to the launching of the Asian Productivity Year.
—H. V. R. IENGAR, Chairman, The E. I. D.-Parry Group, and formerly Chairman, National Productivity Council.

Production of Quality Goods for Overseas Markets Urged

In observing the Asian Productivity Year (APY) during 1970, which is being organised under the auspices of the Asian Productivity Organization, the National Productivity Council of India will be launching special programmes to emphasise the role of productivity in national economic growth. This initiative of the National Productivity Council deserves full support and encouragement from the industry as well as the government.

I take legitimate pride in having had the privilege of starting the National Productivity Council and developing during the first four years of its existence, the range of its programmes and activities. I have watched with great satisfaction the development of the productivity drive through the Council, its Regional Directorates, and the Local Productivity Councils spread all over the country.

At the present stage, when the country is seeking to take a big stride forward, and to attain, as early as possible, a take-off stage, greater productivity by optimum utilisation of all capacities in factories and fields may perhaps be singly the most important factor leading to economic growth. I am glad that APO has selected "Quality and Reliability" as the theme of APY-1970. The improvement in quality and reliability is important not only from the point of view of domestic markets, but also for meeting the sophisticated standards of overseas markets. For the improvement of quality it is necessary that the attitude of all major interests involved in productivity—workers, employers, government and the community—must be oriented to the need for building quality and reliability in their products through the application of productivity techniques.

I wish the Asian Productivity Organization and the National Productivity Council of India all success in their efforts to promote the cause of productivity.
—H.D. SHOURIE, Director-General, Indian Institute of Foreign Trade, and formerly Executive Director, National Productivity Council.

Cooperative Sector: Need to Enhance Productivity Level

With the exception of Japan, Asian countries have not yet solved their problems of poverty and rapid economic growth. Achievement of higher levels of productivity in the industrial, agricultural and other areas of human endeavour has been proved to be the secret of the affluence and growing prosperity of the advanced countries of the world. Though the productivity promotion movement in Asia is of recent origin, it is encouraging to know that the Asian Productivity Organization has decided to observe 1970 as Asian Productivity Year. This reflects a sense of self-confidence in the APO and the feeling that the Productivity movement to be effective has to be progressively dynamic. I wish success to APY-1970, and I hope that in further propagating the concept and practice of productivity we would not lose sight of sectors of human activity which have not received the needed degree of attention from productivity experts. The more prominent among these are the cooperatives and public administration. With the growth of these sectors, it is essential to enhance the level of productivity in their operations to ensure that their expansion otherwise does not retard the impact of productivity in sectors where the movement has found favour. — **N.K. Bhojwani, formerly Executive Director, National Productivity Council.**

Vital Stake of Asian Management

It gives me great pleasure to send this Message on the occasion of the launching of the Asian Productivity Year which India is celebrating in 1970.

It was my good fortune to have participated in the deliberations of the Asian Productivity Organization (APO) which resulted in the decision to observe 1970 as the Asian Productivity Year. It is with nostalgic memories that I recollect that my colleagues and I in the National Productivity Council had planned and coordinated the activities of India Productivity Year-1966 under difficult circumstances. The experience of India in organizing and conducting the very first Productivity Year in the Asian Region, under the dynamic leadership of Mr. NN

Wanchoo, Chairman of the NPC, must have made a signal contribution in the planning of the Asian Productivity Year-1970.

Productivity is a *must* in any sphere of socio-economic activity, and this is even more compulsive in developing or 'growth' countries. Under the able stewardship of my predecessors, Mr. HD Shourie and Mr. NK Bhojwani, and my successor, Mr. BN Bhattasali, the NPC has made significant strides in the fields of Agricultural Productivity, Fuel Efficiency, Consultancy Services, managerial and supervisory development programmes, and dissemination of productivity news. India's persevering efforts at promoting the philosophy, concepts and techniques of Productivity have won her international acclaim.

As the Secretary-Treasurer of the Asian Association of Management Organizations, I would like to express, on behalf of my colleagues in member-management organizations in Asia, that the Asian Management has a vital stake in the Asian Productivity Movement—for management is an integral part of productivity. Reflecting the sentiments of our member-management organizations, I would like to avail of this opportunity of assuring the APO that we would strive our very best to contribute to the success of the promising programmes of the Asian Productivity Year. **—K. PENNATHUR, Secretary-Treasurer, Asian Association of Management Organizations, and formerly Executive Director, National Productivity Council.**

Universal Need for Better Quality
—A. N. Ghosh

It is gratifying to learn that India, as a member of the Asian Productivity Organization (APO), is observing 1970 as the Asian Productivity Year (APY).

To raise the standards of living of their teeming millions and to catch up with the developed nations of the world, Asian countries have to make sustained efforts to increase their industrial and agricultural productivity. While, over the years, various countries of Asia, including India, have taken strides towards increasing their overall productivity, the productivity increase has not been uniform. Thus, there is a great need for encouraging mutual collaboration among Asian countries for the promotion of productivity through synchronisation of activities. In this task, APY can be expected to play a significant role.

The Asian Productivity Year, which will aim at achieving greater prosperity through productivity, will have Quality Reliability as its theme. There is a universal need in Asian countries for improving quality and reliability of products. Standardisation and quality control play a vital role in improving and maintaining the quality of products, reducing costs, minimising wastage, rationalising varieties, and increasing productivity.

It is hoped that the observance of 1970 as the Asian Productivity Year will generate among the Asian countries standards and quality consciousness, which will be instrumental in raising productivity and improving the quality of products.

I have great pleasure in sending my best wishes for the success of the Asian Productivity Year in achieving its objectives. —A. N. **GHOSH, Director-General, Indian Standards Institution.**

Special Approach Needed

I am glad to know that the Asian Productivity Year is being celebrated in 1970. The relevance of the decentralised development in the context of a socialist society is universally accepted. The problems of its development are by now clear, and it should be possible to improve their technology and efficiency in a great measure. The most important problem one has to face is the innumerable number of small operators and special difficulties of the application of modern and sophisticated methods. They call for a special approach in their sociological and traditional context. I believe that the productivity techniques can play a key role in this sphere. I wish all the success for APY-1970. — **U.N. DHEBAR, Chairman, Khadi and Village Industries Commission, Bombay.**

FICCI Chief Sees Major Role for Productivity Organizations in Asia

I am happy to learn that India is celebrating the Asian Productivity Year 1970 to be launched by the Asian Productivity Organization.

The Asian Productivity Organization, during the first decade of its existence, has embarked on a wide range of regional programmes designed to promote productivity consicousness so that men and material are put to the best use. At the centre of all activity, scientific or cultural, is the human being. It is only by finding ways and means by which he can use his physical and mental powers best that productivity can be pushed up. Equally important is the choice of technology. This has to be related to the socio-economic conditions. Fortunately for us in India, major positive changes are under way, both in industry and agriculture. To what extent this process can be carried forward at an accelerated pace and how quickly we can improve the living conditions of our teeming millions will greatly hinge on movements for promotion of productivity. It is in this context I see a major role for productivity organizations in Asia.

I trust the celebration of the APY by India under the auspices of the NPC will help carry the message of productivity to all segments of our society. My best wishes for the success of the Asian Productivity Year.—**RAMNATH A. PODAR, President, Federation of Indian Chambers of Commerce and Industry.**

Associated Chambers' Support

We in the Associated Chambers are very acutely conscious of the need for improved productivity, and we consider that the National Productivity Council is performing outstandingly valuable services in promoting the concept of industrial productivity. I hope that the decision to celebrate Asian Productivity Year during 1970 will be attended with the success which it deserves, and I can assure you of the wholehearted support and cooperation of the business interests represented by the Associated Chambers.—**J. M. PARSONS, President, The Associated Chambers of Commerce and Industry, Calcutta.**

Collective Responsibility of All,
Says Naval Tata

I am glad to hear it is proposed to launch the Asian Productivity Year which India will be celebrating in 1970.

Productivity does not imply merely increasing the volume of production or forcing the labourer to work harder at his job. In the broadest sense, it refers to the problem of using the available resources in the most efficient manner, of using them to produce as much output as possible, at the lowest possible real cost. As such, productivity involves a series of decisions at various levels regarding allocation of resources. While at the macro-level the decisions may relate to investments proposed in different sectors of the economy and the future composition of national income, the decisions at the micro-level may concern scrapping old machines to instal new ones and introduction of incentive schemes to motivate the worker.

It is, therefore, obvious that productivity cannot be treated as the function of any particular group in the economy. It is the collective responsibility of the State, the workers and the management. All of them need productivity-consciousness in equal measure to ensure that the nation's economic effort is not wasted through misapplication or misdirection. The National Commission on Labour, which has recently submitted its report, has recommended that " the objective of increasing productivity must be raised to the level of a high national purpose. "

I wish all success to the efforts of the National Productivity Council of India in implementing some of the programmes of the Asian Productivity Organization.—**NAVAL H. TATA, President, The Employers' Federation of India.**

Offer to Cooperate with A.P.O.

I am very glad to learn that India, along with other member-countries of the Asian Productivity Organization, will be celebrating Asian Productivity Year (APY) in 1970.

There is no more urgent task before the developing new nations of the Asian region than the improvement of the living standards of their peoples through the maximization of rapid economic growth and equitable distribution of the fruits of that growth.

It is heartening to note from the programme of activities of the National Productivity Council that APY will be a part of a Five-Year Plan that is being implemented with the objective of achieving greater prosperity through productivity. The emphasis on Quality Reliability (QR) in the theme of APY is particularly appropriate to the requirements of the economies of the countries of the Asian region, if they are to achieve competitiveness in international markets, so necessary for augmenting their export earnings.

The Accountancy profession is eminently qualified to contribute significantly to the measurement and communication of economic, financial and other data, essential to the tasks of planning and controlling economic activities. As President of the Institute of Chartered Accountants of India, which is the official organ of the Accountancy profession in the country, it is my proud privilege to offer the services and cooperation of the Institute and its members to the Asian Productivity Organization in the furthering of its objectives.

I wish APY every success in the attainment of the worthwhile tasks which its organisers have placed before themselves.—**H.B. DHONDY President, The Institute of Chartered Accountants of India, Calcutta.**

A Real Package Programme

1970, the Asian Productivity Year, has real and timely significance for the Asian region, and particularly India.

In this country, we have inherited an old-fashioned economy, but now a modern sector also, with its wide and varied range, is developing simultaneously. The smooth and efficient functioning of this complex presents difficult problems for which there are no short-cut solutions. Productivity, in such a situation, is quite essential, but not so easy to achieve. Slogans alone will not be enough. Nor will it do to talk of productivity and apply it in a narrow context.

The correct course would be to convince the top managements, middle cadres, and, above all, trade unionists and workers themselves of the essential

significance of the productivity programme, and to prepare them for their respective and joint roles in its fulfilment. It is very important that such organised effort should extend over the whole area, and cover all levels of our economy.

The advance along these lines is beset with many handicaps, but they can be overcome. The first pre-requisite for success, however, is a clear understanding of the concept, and what it involves on the part of those responsible in the three parties, viz. management, workers, and administration. With faith, perseverance, and cooperative effort, a great deal can be achieved.

Obviously, therefore, productivity is a real package programme, and we have much leeway to cover even for creating the preconditions.

I would urge that the APY be put to good use in creating an urgent and earnest realisation of this serious gap, so that the necessary cooperative efforts shall be made to launch, in a real and effective way, the whole national productive apparatus for steadily improving productivity.

On behalf of INTUC, I send my best wishes for the success of APY-1970.
—**GULZARILAL NANDA, President, Indian National Trade Union Congress, New Delhi.**

Essay Contest for Supervisors and Foremen During the Asian Productivity Year-1970

The National Productivity Council (NPC) invites Supervisors and Foremen to write Essays/Articles, not exceeding 3,500 words in length in English or Hindi, on the following topic:

WHAT I HAVE DONE TO IMPROVE PRODUCTIVITY AT MY WORK CENTRE THROUGH ELIMINATION OF WASTES AND INCREASING THE VALUES OF THE OUTPUT.

2. The following prizes are offered:

First Prize   —(One) Rs 300 with a Certificate
Second Prize—(Three) Rs 100 each with Certificate
Third Prize —(Ten) Rs 25 each with Certificate

3. Entrants to the contest should be employed in any industrial or other organisation in the capacity of a Supervisor or a Foreman for not less than two years.

4. Two copies of the Essays/Articles, neatly typed or written, should be submitted through their respective Heads of Departments. All articles submitted will become the property of NPC, and will not be returned.

5. The results of the contest will be announced early in January 1971. The decision of the NPC on all matters pertaining to the contest shall be final.

6. The envelope containing the Essays/Articles should be superscribed "Contest for Supervisors and Foremen," and reach the **Assistant Director (Coordination), National Productivity Council, 38-Golf Links, New Delhi-3,** *on or before July 31, 1970.*

Asian Productivity Year-1970

National Essay Contest for College Students

All College Students including Research Fellows registered in any University or its affiliated colleges in India are eligible to contribute original papers in English, not exceeding 5,000 words in length, on the following topics as relevant to them:

(A) Students of Arts, Commerce or Management Subjects :

"An elaboration of three most important Social and Economic Factors which hinder the rise of National Productivity, and ways and means to overcome these."

(B) Students of Science, Technology, or Engineering Subjects :

"An elaboration of three most important Production Technologies whose development would substantially mitigate the unemployment problems among the technical personnel, giving reasons."

The following prizes are offered:

	A Rs.	B Rs.
First Prize —one	500	500
Second Prize—one	300	300
Third Prize —three	100 each	100 each

Candidates should submit three copies of their Essays through the Heads of their respective institutions, neatly typed in double space with 4 cms. margin. All Essays submitted will become the property of the National Productivity Council, and will not be returned.

The results of the contest will be announced early in January 1971. The decision of the NPC on all matters pertaining to the contest shall be final.

The envelopes containing the Essays should be super-scribed "Essay Contest (APY)", and reach

The Assistant Director (Coordination)
National Productivity Council,
38-Golf Links, New Delhi-3

on or before July 31, 1970.

of Europe; this will replace the usual annual report and will lead to a full-scale discussion.

Important as all these separate occasions will be, the 50th anniversary is no one-day affair, or even one-year affair. Several countries are now considering, for example, a contribution to the Endowment Fund of the International Institute for Labour Studies in Geneva; others may finance fellowships at the International Centre for Advanced Technical & Vocational Training in Turin, Italy, or donate equipment and training materials to the Centre. In other cases, endowments to mark the anniversary are to be made to a country's own labour colleges, to universities for worker fellowships, or for library and research facilities in social problems.

Future Tasks

Lasting memorials of this sort will presumably not be the work of governments alone. Labour organisations and employers will no doubt initiate similar enterprises. Educational institutions in many countries have indicated that they will make their own contribution to the anniversary by including studies of the work and future tasks of the ILO in their 1969 programmes.

The stage is set. The 50th anniversary of the ILO promises to be one of the outstanding events of the year 1969. It is an event that affects all who work, all who employ workers, all who have responsibility for social policy and for the planning of production and development, all who are concerned with social progress and the rights of man.

The first half-century has shown that the world needed an international labour organisation. The aim now must be to develop the ILO's activities to even greater effect. That is the resolve which the representatives of the governments, employers, and workers of more than 100 countries have expressed by their decision to celebrate the 50th anniversary of the ILO.●●●

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Lord Snowdon

"...Honest craftsmen would starve if there were more like him around. He can stitch and lay carpets, knock up bookshelves and cupboards in no time, paint walls, hang wall-paper with professional skill, operate an acetylene cutter for kitchen steelwork, repair and re-upholster furniture, and is a dab hand with curtains, cushions and hangings of all descriptions. He can, indeed, transform a bare room into a colour supplement fantasy before you can say string along. Needless to say, he designed his wife's engagement ring, though the Queen officially insisted on providing the wedding ring herself".

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about
the Special Issue on Computerisation, I* & II

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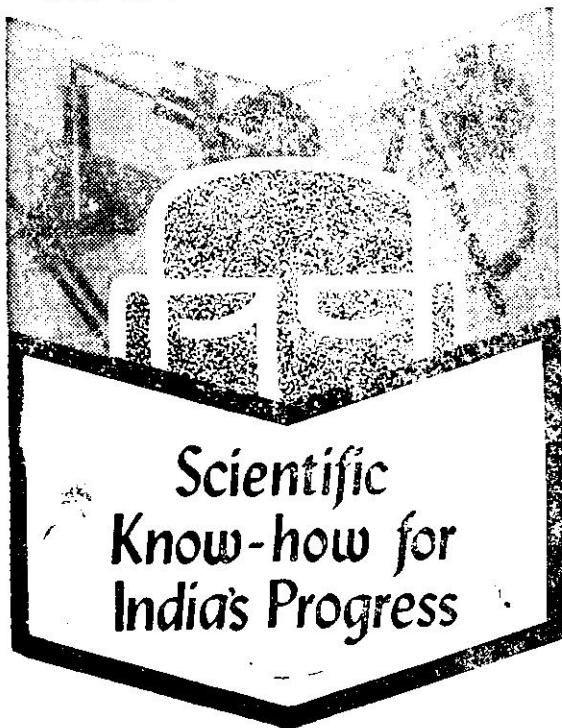
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NATIONAL PRODUCTIVITY COUNCIL

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PRODUCTIVITY

Productivity in Asia

IT IS A STRANGE BUT HAPPY COINCIDENCE THAT EXACTLY 10 years ago, when this Journal had just started its career, we wrote in a leading article: "A realistic, scientific attitude to life and to social affairs is the first ingredient in the cure of 'unproductivity' attitudes that have enveloped the countries of Asia for ages past.   We need in the first instance a correct and sound philosophy in terms of the realities of the social and economic situation in Asia."

And we have been conscious of our common destiny with the countries of Asia: "....it is a matter of life and death with us that we grow two blades of grass where one grew before. The man-land ratio is probably the most unfavourable factor that this country faces in the course of its economic development.   Probably other countries of Asia are as disadvantageously placed. China, with its more than 600 million, Japan and Indonesia with tragic overcrowding on small islands, face almost identical problems...it is significant that of all these countries, Japan is doing remarkably well because of the high efficiency of its men and machinery...." We wrote this in the very first issue of this Journal. brought out in the autumn of 1959.

Now because of our intimate association with the Asian Productivity Organisation, of which the Government of India is a member, we are naturally interested in contributing what little we can to the success of the Asian Productivity Year-1970.

Despite physical contiguity. being by and large situated in one compact land mass, stretching from the Mediterranean to the Pacific, flanked by the beautiful islands of Japan, the Philippines, Indonesia, Ceylon, with their ancient civilisations—an intimate and integral part of the Asian

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*We intend to bring out a Special Issue on Productivity in Asia, early this year.   Intellectuals, all the world over, who have worked on any aspect of the Asian Economy, or any part of it, are invited to write for this Special Issue. Two copies of the MSS, typed three spaces, one third margin, may reach the Editor not later than 30 April 1970.   There is no limit to length in case of academic papers, but normally an article may not exceed 5000 words; and it must be richly illustrated and be religiously free from generalisations.

Culture, dating from prehistoric times—Asia has suffered tragic fragmentation during colonial times with the result that the very concept of Asia has become somewhat amorphous, having lost its economic identity, so painfully built up by travellers and traders, who in ancient times, dared high mountain paths, now accessible only through helicopter. Even the cultural identity has been submerged under archaeological debris and outmoded names of Sanskritic origin.

Under these circumstances, to give reality to the concept of Productivity in Asia, as the APO has been doing for several years, is really a heroic task.

And if we go over the list of countries that, according to the United Nations, make up the Continent of Asia, we shall see what a formidable job it would be to rouse Productivity Consciousness in a region of this size and heterogeneity. Alphabetically these countries are: Afghanistan. Bahrain, Burma, Cambodia, Ceylon, China, Cyprus, Hong Kong, India, Indonesia, Iran, Iraq, Israel, Japan, Jordan, Korea, Kuwait, Laos, Lebanon, Malaysia, Maldive Islands, Mongolia, Muscat and Oman, Nepal, Pakistan, Philippines, Qatar, Saudi Arabia, Singapore, Southern Yemen, Syria, Thailand, Trucial Oman, Turkey, Viet-Nam, Yemen.

Of these, at the moment, the members of the APO are, in alphabetical order: Ceylon, China (Taiwan), Hong Kong, India, Indonesia, Iran, Japan, Korea, Nepal, Pakistan, Philippines, Singapore, Thailand, Viet-Nam. The remaining are potential members; for the APO is making continuous efforts to enlarge the membership of APO to all the countries of Asia; for it is only in the fitness of things that APO should cater to the needs of all Asian countries, for Productivity is a universal need.

We in India particularly appreciate that in this year 1970 in such an important non-political and non-controversial area as Productivity, the countries of Asia would meet frequently, not only in ceremonial gatherings, but also in expert groupings, training programmes etc. etc., exchange ideas and experiences, build up a common platform, so that when the time comes for an integrated Asian Polity, these many streams could be canalized into a Common Brotherhood. In that spirit, we welcome the inauguration of the Asian Productivity Year.

And if the APO is to serve its purpose, it must build itself upon the realities of the situation in Asia. We have at the moment, taking all the countries of Asia, roughly speaking, a population of approximately 2000 million out of a world population of nearly 3,600 million, that is, roughly 56 per cent. On the other hand, we occupy only 27.5 million sq. kilometers out of a world area of 135.7 million sq. kilometers, that is, 20.6 per cent. Thus with 21 per cent of the world area, we have to sustain 56 per cent of the world population. **To break even with the world**—if we dare put it that way—we have in fact to be proportionately more productive than the rest of the world!

As it is, we have a Productivity Gap between Asia and the rest of the world that is indeed breath-taking; and if we go by population alone, the position will worsen, for our rates of population increase are far higher than those of the western countries.

We can put alongside some of the statistics, which the economists in their jargon call "real" per capita national income, steel, cement, milk etc. etc.—but they are so pitiable, and they have been hashed out so often in the recent arguments about the developing countries, that one feels rather awkward in rattling them too frequently.

It looks like a race between the hare and the hound, for the developed countries have for centuries accumulated capital, acquired industrial skills, while at the same time taken steps to restrict

munities or the State would own power-houses, just as they have their grazing pastures. But where there is no electricity and no machinery, what are idle hands to do? I would prize every invention of science made for the benefit of all....The heavy machinery for work of public utility which cannot be undertaken by human labour has its inevitable place, but all that would be owned by the State and used entirely for the benefit of the people. I can have no consideration for machinery which is meant either to enrich the few at the expense of the many, or without cause to displace the useful labour of many....Take printing presses. They will go on. Take surgical instruments. How can one make them with one's hands? Heavy machinery would be needed for them...."

Gandhiji was really a rationalist and above all an egalitarian. In an article published in the *Harijan* (16 March 1947) he wrote: "I have no doubt that if India is to live an exemplary life of independence which would be the envy of the world, all the *bhangis*, doctors, lawyers, teachers, merchants and others would get the same wages for an honest day's work."

It is nearly 23 years since this was written. Probably at this distance of time, Professor Gunnar Myrdal's academic judgment (in *The Asian Drama*) would be broadly and generally acceptable, with regard to the Mahatma:

"Gandhi, although he strove to and actually did maintain—and, over the years, even intensified—his ties with tradition and religion was, in this context, more than in any other a true westernized liberal, indeed a radical and a revolutionary, whose demand for drastic changes in the social and economic order was heard throughout the subcontinent. Until Gandhi's crusade, social and economic reform was discussed very little, either in India or anywhere else in South Asia. Gandhi's egalitarianism became one of the links between him and the radical and rationalistic intellectuals of Nehru's type...."

However, the Mahatma's life really lay outside Myrdal's socio-economic categories. On one of his birthdays, the inmates of his ashram wished Gandhi a long life. Replying to their greetings, he answered characteristically: "You have wished me a long life. All I want is to spend the rest of my allotted days speaking the truth, thinking the truth, dreaming the truth. I care for little else." ● ● ●

Satyagraha as a Technique

"1. 'Satyagraha is a relentless search for truth',
2. 'Satyagraha is simply the practice of truth', and
3. 'Satyagraha is nothing but a new name for the law of suffering'.

Here in these three formulations, I believe, we have the heart of the matter. Combining them, I would define Satyagraha as the perception, practice and propagation of truth. In none of these definitions have you anything that smacks of a tool or technique or method. Being truthful to the core of one's being, which is what it all amounts to, it can hardly be described as a technique. Indeed, if one practises truthfulness as a technique, to that extent one is dishonest and untruthful."

—T. K. Mahadevan

The Fusion Process of Nuclear Energy

IN OUR SPECIAL ISSUE ON FULL ECONOMY*, WE WROTE IN THE LEADING ARTICLE:..."IF WE want to build a highly productive economy, we have to think out and work out a high-supply, low-cost fuel economy—an imperative for a high growth rate"; and there was a rider: "...now the techniques of nuclear fission have lifted bodily the supply curve of power...."

We may now add another rider that the fusion process is likely to escalate the supply curve, in a far more radical manner than the fission process did; and it's time that our nuclear experts went deeply into the technical and economic aspects of the fusion process, so that at least in one respect, the Technological Gap may be kept as narrow as it was in the time of the late Mr. Bhabha, and as his distinguished successor, Dr. Vikram Sarabhai, has attempted to do.

The fact of the matter is that our energy requirements are likely to mount, with population increasing at a compound annual rate of 2 to 3 per cent, and industrial output at a compound rate of 8 to 10 per cent. Thus the output of energy may at some critical time become a serious inhibiting factor in the Growth Process.

The Energy Survey of India Committee had estimated the country's energy requirements to rise to 446 million tonnes (in terms of coal replacement) by 1970-71, 635 million tonnes by 1975-76, and 895 million tonnes by 1980-81. In terms of electric power, we have now an installed capacity of nearly 15 million kW., and it is scheduled to rise to 22 million kW by 1973-74, the end of the Fourth Plan. This, however, is nothing compared to an estimated requirement of 240 million kW by the year 2000, when our population may well rise to 900 million, with a standard of living and a level of industrial technology, incomparably higher than in the Decade of the Seventees.

We have, therefore, as a matter of sheer survival, to hammer out new techniques of power production, which enable us to produce a lot more power, lot more cheaply; and the Fusion Process offers a promising prospect.

In fact, the Soviet Union is reputed to have nearly reached a breakthrough stage, as evidenced by their import, on order, of a 6-tonne thermometer, specially designed to measure abnormal temperatures of gas, akin to what happens in the solar mass, in which the chain reaction of fission and fusion occurs at astronomical temperatures. As usual, there is a secrecy about the whole know-how, but we know the basic facts; and we can as well experiment, equipped as we are in essential techniques and gadgets. The rest, we should be able to design, as others are doing.

Of course, there is the question of Finance, but others—particularly the Fusion Scientists—appear to be equally hard up. In fact, at the Conference of Nuclear Fusion Scientists held at the Culham Laboratory in the U.K. in September 1969, practically all the assembled physicists complained seriously of the niggardliness of investment in the fusion process. Even in the Soviet Union, where outstanding progress has been made in the line, it is said that they are spending no more than £ 10 million on Fusion, and Mr. I.N. Golovin of the Kurchatov Atomic Energy Institute is reported to have remarked that the Russian technocrats would not be easily persuaded to spend more on fusion. In the U.K., funds spent on fusion have been reduced over the years; and Dr. Hans Kronberger of the U.K. Atomic Energy Authority informed the Conference that before funds could

their population. Consequently, in the Productivity Race, the leeway to be made up in Asia is enormous; hence the importance of the work of the Asian Productivity Organization.

There is no time for weeping and whining: we must build up an adequate programme, considering the requirements of the situation in Asia; and we must keep our feet on the ground; for in the western countries, Productivity is equated essentially with Work Study, Rationalisation etc. etc., since their main problem is the scarcity of labour. Our problem is exactly the opposite. We have, as Mahatma Gandhi said, "an ocean of labour wealth". There is no escape for us but to build up Productivity on a high population base.

Not that in Asia we do not require such Productivity Techniques as Work Study. We do very much require them, particularly at the Planning Stage of our Projects, for to employ people and then to lay them off on account of rationalisation, would work untold hardship in countries with a considerable backlog of unemployment and underemployment.

In Asia, our primary requirement is Food and Work for the People; and our Productivity Programmes must be powerfully oriented towards the achievement of these imperatives of social policy. In fact, we have no alternative; and we can make Productivity acceptable to the Governments and the peoples of Asia, if it answers their primary needs. ● ● ●

The Asia Drama*

" . . . In a sense, the most fundamental difference in initial conditions between the South Asian countries today and the Western countries in any period of their pre-industrial phase is the difference in the pace of history. A telescoping of change has become the only alternative not only to continued stagnation but to regression. . . . .

"The need is for telescoping changes, for having them take place faster than they ever did in the early development of the Western countries, faster even than they are now taking place in those countries. But the long stagnation in the underdeveloped countries has solidified institutions and attitudes, and hardened resistance to change in all strata of their population. The onslaught of modernisation from outside, without the gradual transition experienced by the Western countries and in the presence of a population explosion, leads to a situation where elements of modernism are sprinkled through a society in which many conditions have remained almost the same for centuries. As Nehru said of India : 'Our country at the present moment is a very mixed country. Almost every century is represented in India : from the stone age in which some tribals live, you may say, to the middle of the twentieth century. We have atomic energy and we use also cow dung.' . . . "

*Prof. Gunnar Myrdal: *The Asian Drama*, Vol. I,. pp. 700, 704

Gandhi : The Model Of Productivity

When we were officially asked, if we had anything relevant to say during the Gandhi Centenary Year, our immediate reaction was naturally in the negative, for we found little in common between the Mahatma and the sort of technical and abstruse subject that Productivity is.

However, on second and maturer thought, the question occurred to us: Was not Gandhiji the Model of Productivity? What is productivity but making the most of one's Time and Talent, and energising the whole surrounding environment so that men and women are inspired and motivated to do likewise: that is, make the most of themselves, both as individuals and as members of society on all planes of living, thinking and acting: whether it is politics or economics; or home or village or factory; life at the ground level, or life of the spirit?

By all these standards of judgment, was not Gandhiji the Model of Productivity? Apart from gods and goddesses of mythology, can we in historical times recall a man or woman remotely equal to the Mahatma in the utilisation of time, whether at prayer, or writing the *Harijan* or organising passive resistance, or running the Charkha Sangh, or the Harijan Sewak Sangh? All time was to the split second productively utilised; all productive and purposive ideas were greedily welcome to the Mahatma; but he was all afire if his goat's milk was not in time, or the prayers were even minutely disorganised; or the meeting went slightly off the point: you could then see the Mahatma in rage, of course momentarily, for he knew all anger was unproductive, and he soon smiled it all away, getting back with all speed to the task in hand.

Analysing his major achievement, the dis-establishment of the British Empire in India, in terms of the Productivity Model, it can be reasonably claimed that Independence was achieved with a quantum of input, really negligible in relation to the world's mightiest empire. In real terms, non-violence was really intended to reduce the level of suffering that the people were called upon to bear; and as a technique, it was a Marvel in Productivity: the Mahatma appraised with the shrewdest accuracy, the resources on either side: the military might and the steel framework of the British Empire, on the one hand, against a poverty-stricken people, thoroughly demoralised by centuries of foreign rule.

Even in Economics, it was the uncanny insight of the Mahatma who perceived immediately that the Indian Economy was totally out of alignment with our peculiar resource-endowment. Really Gandhiji's ideas were based on the fundamental of total social productivity: "...we are poor but we have an ocean of labour wealth...planning has to coordinate the available factors of production to produce the best possible results not only material but social and cultural. Any planning in our country that ignores the absorption of labour wealth will be misplanned. Our analysis has shown that centralised method of production, whatever may be its capacity to produce, is incapable of finding employment for as large a number of persons as we have to provide for...." This is true even today. Against a population of nearly 550 million as on 1 January 1970, registered factory employment accounts for only 5 million approximately !

In fact even the case for machinery, particularly in the context of the socialist pattern of society that has been decided upon by our sovereign Parliament, could not have been better stated than by Gandhiji himself: "If we could have electricity in every village home, I should not mind villagers plying their implements and tools with the help of electricity. But then the village com-

be sanctioned for the big prototypes that the Fusion Process requires, the researchers must produce firm cost estimates. Obviously Science and Bureaucracy go ill together. Even in the U.S.A., where they are more generous, the fusion laboratories are hard up in respect of their basic research projects.

Now the problem appears to be relatively simple. Just as the hydrogen bomb is reputedly superior to the original atomic bomb, there is a prima facie case as to the relative efficiency of the two processes for peace time production of electricity. The original atomic bomb exploded by the fission process; the hydrogen bomb explodes by the fusion process. While we do not want the bomb, we want to produce electricity on the largest possible scale and what's most important for us, on the cheapest possible terms.

And this brings us to the question of materials for each of the two processes. The hydrogen process depends for its fuel elements on sea water, whereas the original atomic fission was based on uranium. Now for the fusion process, we do not require uranium, enriched or otherwise: we take the supplies from the seas that surround us; and we never need be short.

And what is more important for mankind, the fusion machine, unlike the nuclear fission reactors, produces no undesirable radioactive waste. Further, the Fusion Scientists claim that the fusion reactor, unlike the fast breeder, is a lot more safe, and a lot more cheap. While we need not be frightened of fast breeders—our scientists can take care of them—it is time, we started investing in the Fusion Process, as offering a possibility of producing nuclear electricity on a large scale, with its Economics, decisively more favourable than that of thermal power, over which so far, the fission process offers only a marginal cost advantage. ●●●

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A Policy for Planets

"Men will be living on the moon by the late 1970s and landing on the Mars by the late 1980s—sooner if some planners get their way. And behind them an entirely new industrial complex will be swinging into gear... Countries that do not take active steps now to join what amounts to a new transport industry are likely to find in five years' time that the technology has advanced to a stage where they cannot even expect to supply components for it......should space go the way of aviation so that rockets become an accepted means of transport in space, and certain planets places to live and work on, then it will amount to a new industrial revolution..."

—*The Economist* (London) 9 August 1969, p. 12.

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All too Human

"Social scientists are human; some, as we know will, are all too human."

In-Plant Training in Oil Engines in Czechoslovakia

J Dubsky*

This article covers the In-Plant Training of the Engineers of the Developing Countries in the field of Oil Engines, held in Czechoslovakia in 1968 under the auspicies of the UNIDO. of which Czechoslovakia is a member.

It may also be said here that Czechoslovakia shares in the long-term development plans of UNIDO, not only by way of annual grants, but also through assistance in the technical training of intelligentsia from the developing countries. It is as a result of agreement between the Czechoslovak Government and the UNIDO that the International In-Plant Group Training in the field of Oil Engines, referred to above, was organised during March-June 1968.

This decision was naturally influenced, no doubt, by the attention paid in Czechoslovakia to the education of her own technical intelligentsia and of industrial workers; also by the suitability of technical and economic conditions of oil engine manufacture in CSSR. The modern research basis of traditional oil engine manufacture of CKD, SKODA and SLAVIA, along with their technical knowledge and practical experience makes Czechoslovakia a good training ground, as compared to countries in which the oil engine operation is quite extensive but in which the conditions for theoretical and practical information concerning progressive design, production and correct maintenance of oil engines have not yet been developed to the Czechoslovak level.

THE INTERNATIONAL IN-PLANT GROUP TRAINING was intended to import uptodate knowledge of the economic operation and efficient maintenance of the oil engine, and of the necessary relations with theoretical research and to project them to modern design, production and maintenance. The lessons involved the use of progressive methods of industrial training under the leadership of experienced specialists from the fields of

*A graduate of Czech Technical University in Praha, the Author is the Director of the Oil Engine Research Institute — CKD PRAHA since 1960. The Institute is engaged in research-development for marine and railway traction oil engines in Czechoslovakia, and works for six production plants. Mr. Dubsky is also the Instruction Manager for the training of Czechoslovak Science Students in the field of oil engines. For the last two years, he has been the chairman of the Line Committee of the Czechoslovak Scientific Technical Society for all the works of CKD PRAHA. In 1968 he was entrusted with the Special In-Plant Group Training in the field of oil engines for the engineers from the developing countries, organised as the first UNIDO course in Czechoslovakia. In fact, this is the subject of the article printed above.

research, design, technology, organization, management, production and economics, along with practical training in laboratories and of employment in workshops.

The organization of the Training, the preparation of the programme content were entrusted to the Oil Engine Research Institute which is the research centre in the field of stationary, marine and railway engines in Czechoslovakia. It is a part of the CKD PRAHA concern and employs renowned Czechoslovak specialists in the field.

A number of technical-research and project-designing teams work in the many laboratories and test shops of the oil Engine Research Institute.

The fact that it is an integral part of the CKD PRAHA concern enabled the organizers of the Training Programme to achieve a high level of pedagogical efficiency through lessons imparted right into the associated production plants at Horovice, manufacturing small oil engines ranging from 30-400 hp and at Hradec Kralove, manufacturing medium and large engines of the out-

puts of 450 to 3000 hp. In fact, all the workplaces of the concern—foundries, machine shops, test rooms, material laboratories—are available for the activities of the Oil Engine Research Institute.

Though this International Training was organized in Czechoslovakia for the first time, every effort was made to benefit by the experience of the Group Trainings organised by UNIDO in other countries. Information was available directly from the UNIDO Secretariat, from the sessions of the Training Directors, also the first-hand experience from the Group Training in textile industries in Poland, in electro-technical machinery in Sweden and in textile machines in Italy.

Twenty technical qualified participants from 12 countries (Bulgaria, Cuba, Ecuador, Ghana, Hungary, Iran, Iraq, Pakistan, Sudan, Thailand, UAR, and Yugoslavia) were selected for the training. The participants were of the following age groups.

Table 1

Age Group	Number of Participants	Percentage of Participants in the Age Group
1. 26—30	7	35
2. 31—35	4	20
3. 36—42	7	35
4. 44—48	2	10

We found that half the number of participants had theoretical training, and half of them had practical knowledge of the subject. Table 2 indicates their background.

Table 2

	Number of Participants	Percentage of Participants
Assistants and Lecturers at Technical Universities	8	40
Maintenance, Technology including Service	8	40
Design	2	10
Economics, Management	2	10

Table 3

Grade	Number of Participants	Percentages
Good	4	20
Average	10	50
Deficient	6	30

UNIDO and the Czechoslovak Government paid special attention to the organisation of training. The Deputy Premier and Minister of Heavy Industry, Mr. Krejci Eng. and the UNIDO Executive Director Dr. Abdul Rahman were the patrons of the Programme. Besides, many other distinguished persons were present at the official inauguration in the halls of the Ministry of Foreign Affairs in Praha.

Establishment and Training Methods

In conformity with the decisions of the UNIDO Training Course Directors, the training programme was prepared particularly from the point of view of practical applications, of the theoretical knowledge gained in school, of professional discussions, of workshop practice and of laboratory training. Its percentage distribution in the practical and theoretical part is specified below:

	% of Time
1. Professional theoretical and practical lectures	30
2. Laboratory training, workshop practice, professional discussion in production plants	47
3. Visits to specialized works manufacturing oil engine accessories	10
4. Lectures on management, Czechoslovak national economy and elaboration of the final technical reports	13

The course content, relating to techniques and economising in manufacture, had the following objectives in view;

Practice in the Production Plants : (Above) Manufacture and checking of the oil engine connecting rod. (Below) Measurements in the series test room of oil engines.

—*Getting the facts about the new techniques in oil engines* (latest designs, important assemblies and accessories).

—*Maintenance and attendance of engines during operation* (analysis of defects, main defects of mounting, putting the engines on foundations, coupling engine with the driven machine, preventive maintenance, fuels, oil etc.)

—*Main application of oil engines from the point of view of their selection* (diesel generating sets, marine engines for small and middle sized vessels, ship engine-rooms, setting of marine engines into operation, railway traction diesel engines, diesel locomotives, stationary engines in modern agriculture, etc.).

—*Principles of technology, checking and testing of oil engines* (organization of production, its technology, test rooms, modern design manufacture, price and cost calculation, etc.)

—*Practical lessons in the production of engines* (measuring and practical training in the manufacture and assembly, in test rooms, in the shipping department, production economics, storage etc.)

—*Visits to Czechoslovak plants, manufacturing oil engine accessories* (pistons, piston rings, bearings, injection equipment, turbo-blowers, crankshafts etc.).

—*Elaboration of the final Report on the selected theme*, providing the possibility to apply the acquired knowledge from the training in the home country.

The structure of the training participants with 50% predominantly trained in Theory and with 50% practically trained, referred to earlier, was taken into consideration for determining the opinions concerning the time devoted to manual exercises. To facilitate training, the participants were familiarised with the basic terms of colloquial Czech and later on, to make the practice in the production works easier, also of technical Czech.

When considering the selection of suitable training methods, the OERI benefited by the accumulated experiences of the CKD which had previously organised courses for larger groups of foreign experts, giving rise especially to

—Problems of human relations entering the foreground between the organiser and the newly created department of trained experts, creating some kind of a micro-collective with its own kind of life.

—Problems of pedagogically technical character connected with the education of a very heterogeneous group.

—Problems of organization of the whole training.

The organisers were well aware of the fact that a certain time had already elapsed since the engineers graduated and that their technical levels would vary; and this determined the thematic sequence of the lecture series. The order of laboratory and of in-plant training was determined in such a way that laboratory training always followed the lecture dealing with the subject.

The precise working programme, including the lectures at the Institute and in the plants, the visits to the production works and the programme of cultural events for the following week, was communicated to the participants in advance. The time table was strictly adhered to. In order to enable preparation in time and good technical and language orientation to all the participants, they were given detailed scripts of the lectures, three days in advance, so that the lecturer might concentrate his explanations on the most difficult parts and especially on the application of the acquired knowledge in theory and practice. The participants could also take their notes; and they were informed that at the end of the training they would get all the 22 lectures properly bound, for their reference libraries.

A qualified interpreter of the English language was present at each lecture meeting, to help the participants to formulate properly their questions concerning the lecture theme, and during the technical discussion. The lecturers of the Research Institute illustrated their themes

by projecting on screen the more complicated mathematical diagrams and pictures. The more intricate figures and photographs were projected by epidiascope so that all the listeners might get a perfect idea of the subject matter.

During training in laboratories and in workshops, the participants were divided for pedagogical reasons into four working groups, set up on the basis of their interests, specialisation and mother tongue. In these smaller groups, each of five, the participants had a very good opportunity to understand and to carry out independently in a practical way all the work in the laboratory and the workshop. The individual groups alternated in a cycle so that all the participants got the full benefit of the training. Each group was assigned a qualified interpreter to smoothen the course of practical training.

Before the termination of the training, the Groups were reorganised according to the interest and specialised selection of the Final Reports of the individual in-plant training participants. In the production plants at Horovice and at Hradec Kralove, the methods were identical, as also a short cycle of lectures. In the lessons, laboratory and workshop training was naturally stressed. The workshop practice took place in foundries, machines shops, assembly and test rooms. In addition to the lectures and training, professional discussions were held in the afternoon hours in the presence of lecturers and technicians of the Works.

To improve upon the pedagogic efficiency of the lessons, Group Training was gradually supplemented by visits to the Czechoslovak Works, manufacturing the main components and accessories of oil engine, the design and function of which the participants had been acquainted with in lectures, laboratories and workshops. Production plants manufacturing accessories were visited only after a practical explanation of the function of the respective component had been furnished to the participants. They were also acquainted with the production programme of the Works and with the organisation of the plant, and thereafter in smaller groups they got to know the manufacturing procedures of the single parts and took account of the validity of theoretical relations and dependencies.

For the first time in the organisation of this type of UNIDO training courses, the graduates, before the termination of training, had to elaborate their final Reports, either on an individual or a collective basis, dealing with the theme selected by the participant and indicating the possibility of practical use on return to the home-country.

The purpose was to prove that the training participants understood the problems of the subject matter and that they would be able to solve factual problems in connection with development, service and maintenance of oil engines in practical life.

When selecting the themes of the technical reports, some points had to be observed, especially:

—the time factor not allowing the selection of more extended themes

—relation to the lectured subject matter, and to the contents of the whole training

—technical specialisation in the field of the individual participant's profession.

In the light of these considerations, three technical fields were selected for specialised work:

(a) The theory, along with its mathematics, to supplement the participants' intimate knowledge of their own problems. This category involved:

—elaboration of an indicator diagram for a certain engine with given value of bmep on piston, value of maximum combustion pressure etc.

—calculation of radial and tangential forces on the crankshaft and the course of torques in the individual points of the shaft as the basis for design work.

—determination of the way how to carry out the measurement of thermal balance of the engine and calculation of the oil cooler for the second caloric output.

(b) Specialisation in the study and nature of Design for training participants in solving similar problems in their jobs. This involved:

- —redesign of a small oil engine with combustion chamber to a direct injection type
- —design of piston for high heat stresses and high combustion pressures with detailed calculation of piston pin stresses, with allowance for experimental checking
- —the study of a medium-sized naturally aspirated engine modification to a turbocharged engine, carrying out the necessary calculations of the turbocharger, proposing the way of checking.

(c) The techniques underlying service operations and works lay-out, for the participants specialised in service, investment and other fields. This involves:

- —lay-out, equipment and organisation of a repair shop of medium size engines of given capacity
- —elaboration of the procedure how to lay down a large engine on the foundation
- —how to equip a power plant, located at a considerable altitude above sea level, with a given character of energy take-off, with suitable oil engines.

At the request of a participant, we added another theme to the programme. "Suggestion of suitable measures for noise damping of a small two-stroke oil engine, based on experiments and their analysis."

The preparation for the elaboration of the Final Technical Reports began in the course of the practical lessons in the production works. During the meetings organised for the training participants, the subject matter of the respective problems was discussed in such a way that they might select in time a suitable theme and accede to the factual elaboration with a definite idea, and possibly with the data. To assist the participants in following up the contents and the technical problems, consultants were appointed for individual themes. Small Group formations, with similar subjects, enabled close touch being maintained between participants and the con-

sultants. Appropriate conditions were created by dealing with psychological bottlenecks and queries during discussion time.

Most of the training participants approached the problems of technical report elaboration seriously and with full responsibility. However, the extent, depth and standard of execution of individual performance varied. In tackling their themes, the participants were aware of the fact that the elaboration would represent them not only in relation to the training organiser, but also in relation to their own country. The majority of the themes elaborated individually were executed in all respects better than those made in collective cooperation. All the participants proved by their work that they understood the principles underlying the technical and economic problems and that they were able, in case of need, to solve similar problems.

The final technical reports, containing the texts, also drawings and diagrams, were bound in compact form, so that the participants could take them home.

During the course, and mainly towards the end of the training, some less important negative features occurred, caused mainly by the fact that the participants had been recruited from 12 countries, extending over continents with very different standards of living, customs, technical levels and languages. It was therefore natural that the participants showed a variety of characters: some showing assiduity, diligence, ambition to get new knowledge, initiative, others, indifference. All these we observed during the training period, according to the attention, interest in discussion, shown by various participants. Some of them, for example, requested for practical personal instruction on machine tools, a more detailed explanation of the programming for the analog computer, information about the special practical measures for reduction of the noise levels, measurements not only in laboratories but also under service conditions, outside the framework of the lessons in their leisure time. Others, substantially less interested, tried hard not to extend the time schedule by frequent inquiries. Some graduates also showed little appreciation of punctuality, discipline etc. The Training

Director succeeded in suppressing the negative features, right from the beginning, during regular and informal meetings, so that during the entire training it was not necessary to resort to disciplinary measures.

After completing the entire programme and after elaborating the Final Technical Reports, the International Special In-Plant Group Training in the Field of oil engines in CSSR concluded. The participants took leave of all the lecturers, the workers of the secretariat and representatives of the plants CKD Horovice and CKD Haradec Kralove in the lecture-room on 16 June 1968. This ceremony was sincere and cordial on both sides and fruitful relations had been established. The specialists of oil engines assured the participants of their readiness to help in the solution of any technical problem that may arise. They were ready to be consulted in case of need, thus ensuring the systematic technical advancement of the specialists from the developing countries. The official termination of the Group Training took place on 17 June 1968. On this occasion, the Director handed over the diplomae certifying attendance at the special international in-plant group training in the field of oil engines for engineers from the developing countries.

At the conclusion of the training, the patron of the course—the Minister of Heavy Industry, Mr. Josef Krejci Eng.,—addressed the participants, indicating the willingness and the duty of the CSSR to assist the developing countries in their technical progress of which the organisation of the Training Course was a clear proof. It may be added that the participants commented favourably on the lessons at the Oil Engine Research Institute, its laboratories and work-places of the production works. They also expressed their interest in individual instructions in the manufacture and in the laboratories: some of them even devoted their leisure time to these matters.

The time-schedule of the training programme extended to 14 weeks. In retrospect, it may be considered from two points of view:

— as too short for mastering the wide, and pretentious, theoretical and practical problems of the field of oil engine manufacture.

— as too long, when despite all efforts of the training organiser to cure the participants of tiredness and nervousness especially towards the end of the training: naturally, problems. of a sociological nature began to appear due to separation from their families, impatience, homesickness and comprehensible fatigue.

It appears that for the next programme of training of a similar nature, 12 weeks may be the optimum.

Material conditions, maintained both by the UNIDO organization and the Czechoslovak Government and the organizer of the training provided all the training participants, during the entire duration of their stay, with a good standard of living, corresponding to that of Czechoslovak specialists of standing, and as such they were also favouably accepted by the participants.

The organisers also made an effort to acquaint participants in their leisure time with the beauties of nature, with the arts and with the people of Czechoslovakia. The secretariat organised a series of group and individual functions, dealing with cultural life, and sightseeing and the interesting things of Czechoslovakia.

At the final session attended by the representatives of UNIDO, the participants expressed their thanks to the training organizer, and also desired that the technical and friendly relations between the training fellows and the Czechoslovak oil engine specialists should continue after they parted company. Accordingly, they decided that all the course participants would contribute news to a regular yearly bulletin which the Oil Engine Research Institute would be responsible for publishing and distributing. In fact, the first issue of the Bulletin, with news received from the participants, was published in March 1969. In conformity with the long-term projects of UNIDO, it is anticipated that similar training course for engineers from developing countries would be organised in 1970; and the acquired experiences and the favourable evaluation of International Training, described above, are a good augury for its repetition in CSSR in 1970, again. ●●●

Futurism:
A Managerial Challenge
of
Tomorrow

Narendra K Sethi*

It is by now clear that Tomorrow is upon us in a manner that it never was. History was once a slow, long drawn out process; and the researcher could take his time in looking backwards and forwards and build up a philosophy of History. Now, a telescoping of time has taken place; and managements that do not take immediate cognizance of the future will soon be outdated. It is in this context that the author has treated Futurism as a Managerial Challenge; for the decade of the Space-Time Travel will demand a new dimension to things, and a whole range of new products and new services that the old world knew not of.

THE PROPHETIC NOVELS OF JULES VERNE, THE cosmic gyrations of H.G. Wells, and the stunning new motion picture of Stanley Kubrick (Space Odyssey—2001) have all focussed upon a relatively new dimension of thought and action: operating in the present-time consciousness, but striving for the business world of tomorrow. They are the breed of the futurists—who incorporate the dimension of futurity in their business planning; in their conceptual and operational philosophy of administration; and in their forecasts of future business activity.

Is futurism just a pastime to bring in some innocent fun in the otherwise placid functioning of the business mind? Is it a fantasy to provide an escape from the hard realities of the present? Or is it truly a meaningful projection into the unknown; into the remote; into the mysterious; into the far-reaching abyss of space and time; into the shape of things and processes to come; into the newer trends of business?

Once Management projects itself into an era of inter-planetary markets, global corporations, instantaneous information processing, hitherto unknown medical, technological, and engineering discoveries, the adventure into the world of the futurists ceases to be a journey into a fantasy-land: it cyrstallizes into a voyage into the world of tomorrow—a concrete reality separated from us by only one (now small) variable, TIME!

The decisions and the plans of today become the realities of tomorrow. Doesn't this mean that the **tomorrow** is a silent but a very significant partner in all business planning and decision-making processes? A managerial mind, with a myopic vision, solely nourished on the thoughts of today may well collapse under the pressures and the challenges of the Future.

A Scene from Tomorrow

Let's review an illustrative study of the future managerial setting as it might appear in the future.

Time:	Early 21st Century
Place:	100 stories under Park Avenue, New York
Scene:	A monthly business conference of the Executives
Agenda:	Review of the master plan for the Galaxy Enterprises, Inc.

*Professor of Management, St. John's University, College of Business Administration, Jamaica, New York, U.S.A.

Present: Senior officers of the corporation (through both physical and electronic devices).

A fully automated office is the scene of this routine meeting. President John McDonald III has opened the proceedings with a brief greeting. "Good Morning, gentlemen! This is the fortieth meeting of the Group-Think. I welcome you all to this session."

The Galaxy Enterprises was founded in 1955 by John McDonald II in the areas of Electronic Data Processing and global communications. McDonald II died in 1970—just fifteen years after the firm came into existence, and he was only fifty years at that time—in the prime of youth and energy. He was put in deep freeze as he could be revived back to life around 1998. The company grew in prosperity in the hands of young McDonald III, who took over the job of the chief executive at the relatively young age of twenty-three. The elder McDonald was revived back to life in 1998 when his chronological age was seventy-eight, but biologically he was not a day over fifty. He was amazed to see that the company which was having an annual sales volume of around fifty million dollars in 1978 (when he was put to sleep) had a yearly sales volume in excess of $ 800 billion. Distribution centres were established in six other non-earth planets in the solar system. His own investment in the firm had grown astronomically. He was very happy, overjoyed and exhilarated. He was present at the meeting when his son called the meeting to order.

"Gentlemen, the master-plan has been put into effect and the results are very promising indeed. The Distribution Control Subsidiary of the Earth reports that there is a very significant improvement ever since the World Trade Treaty went into effect in 1990—which integrated all the countries of the earth in a solid economic unitary system, doing away with separate currencies, doing away with customs and tariffs, and substituting instead an electronic system of deposits and liabilities for each country. Since no point on earth is more than twenty minutes away in distance-time, distribution policies have been further revised and we now have a centra-

lized inventory unit from where the distribution is effected in less than an hour on any point on earth, and less than a day in any part of our solar system where we have subsidiary trading rights.

Our administrative employees are all utilized in high level information work—with no manual work of any kind. We have no offices now—just information transmission microwaves through which their reports are received and controlled. On an average, our employees receive $ 150.000 in terms of the 1970 dollar, and their working commitments to our organization is just six hours a week. The average biological age of our senior executives is only seventy. Once they reach the mandatory freezing age of ninety, they are put in deep freeze, to be revived as and when necessary and desirable. Last month, we needed an executive who could interpret the old accounting records of our Chicago branch of 1975, and we had to revive Mr. George Peabody."

The mention of the name of George Peabody revived old memories in the fragile mind of the elder McDonald. Peabody was one of his earliest associates in the company fifty years ago. He felt a chill fastening upon his heart. Is it fifty years ago? Seemed like only yesterday. Didn't it?

The young chief executive was glowing in the joy of his company's continued prosperity: "Our products have improved tremendously. We are now capable of forecasting very accurate, minute, and intricate changes in the customer behaviour, social mores, and conceptual aspects of the markets through the new generation of the computers. This forecast of the behavioural forces was perfected about five years ago when Joseph Gillespie perfected his theory of an 'Instrument Processing for Limitless Variables.' We have sensory devices in selected social areas and human minds which bring in the desired information. In this way, we seem to have totally gotten over the last major obstacle of the business—the unexpected failure of the products to show results. Our product mortality rates have come down very very drastically. In fact, this new system of ours is our most profitable

single product to be sold in the global and inter-planetary markets."

The committee of executives was listening to the speech of the young president. Everyone was involved in the planning phase of these new developments long before they were put into effect. It was indeed nice to learn that the plans were so very successful.

The elder McDonald was visibly impressed not only by the sophistication of the plans and their effective implementation, but also by the setting of the meeting itself. He remembered quite vividly his own office at 64th Street in Park Avenue on the Twenty-Seventh floor of a large glass and aluminium complex. Now he was sitting in a circularly designed office with changeable plastic and electronic fixtures of both aesthetic and functional beauty, one hundred stories under the ground. He had been told that the very "in" thing is to have offices either underground or on the ocean floor.

There was plenty of wasted space which was being increasingly used by these modern offices. The offices themselves were mobile with moving foundations. They could be shifted on air cushions under the earth and ocean waves on the sea-floor through electro-magnetic and sound control. This made the work of office super-vision and central administration an easier one. Large subterranean metropolises had sprung up in addition to various ocean townships. McDonald at that time happened to be in one of these himself.

When the entire master plan was reviewed and the business of the meeting ended, it was adjourned till next month. The McDonalds walked out of the conference hall arm in arm.

"Dad, how do you feel attending this meeting after you awoke from the sleep? Do you approve of our work? I have only tried to extend your fine tradition of service, product improvement, and innovation which you had pioneered in this organization. You might have noticed perhaps that quite a few of these products and processes which we are now universally exploiting were in the blueprint stage when you headed the com-pany."

"Yes, indeed. I have observed this. And also some more. What I had thought, dreamed, and envisioned is now before me—my own eyes --in a concrete form. I am surprised but not astonished. Otherwise, my boy, do you really think I would have agreed to be put to sleep if I did not expect all this and lots more to be real some day,—some day when I could see them. That some day is here."

The "future" is sooner in time than we seem to realize. Let's not forget the truly visio-nary insight and judgment, in the name of passive practicalism and pragmatism. Since the corporation has an eternal charter, the managerial mind should also be truly broad and extensive enough to focus on the longevity of the business organization.

We can't (and shouldn't) approach the longevity of the corporation through the medium of an ephemeral administrative strategy. The futurity of the business scene should be fully matched with the futurity of the managerial vision. Or else, it will be an ill-matched part-nership.

Management today foresees the future and in doing so, it also sows the seeds for the deve-lopments and changes of the future. It is this interaction with futurity which is the hallmark of the true manager.

Many new changes and challenges are already noticeable on the managerial horizon: changes in the interdisciplinary content of organizational administration; logistics; distribution networks; information processing; product and process breakthroughs; office supervision; executive fluidity and decision-making process; physical and chemical discoveries, their legend is long. And managers have a clear choice: incorporate the futurity in the present operations and be assured of a growth-oriented business or continue to delight in the present successes and present products, of a transitory nature and (like an epicurean) have no worry or regard for tomorrow; for tomorrow we die. But tomorrow we may be in deep freeze, and wake up the day after, as a Rip Van Winkle.●●●

Discriminating Ability
of
Several Objective Tests

KP Bhattacharyya, S Chatterji & M Mukerjee*

By scrutinising the syllabi of several management courses it is observed that these courses cover a large variety of subjects and the final grade is based on a composite score obtained by giving different weights to different subjects, and then adding them together. Due to the fact that the courses do not intend to provide intensive training in any one of the subjects and due to there being a large number of subjects, it is a problem to predict success with the help of a single battery of tests containing a few tests. In an earlier study by two of the present authors[1], it was observed that this was a special problem with management courses though the multiple correlations of the objective tests with the final grade earned by the candidates as the criterion, were fairly high. It is obvious that if the criterion score were not so heterogeneous in nature, a much higher value for the multiple correlation could have been obtained. With a view to investigate the problem further, this study was undertaken.

IT WAS PLANNED TO FIND OUT THE EXTENT to which performance in each of the subjects (taught in a particular management course) was predicted by the selection tests and also to find out which one of the subjects was predicted, by which one of the selection tests. Information regarding the last point may be utilised for including some special tests in the battery.

To examine the relationship it was decided to develop expectancy tables for each of the tests included in the battery against the marks obtained by the students in their class examination. Expectancy tables provide precise knowledge of the probability of a candidate's getting a particular rank or score or being grouped in a particular category or being identified as pass or fail on the basis of a predictor test. Describing expectancy tables, Freeman says:

"These provide a relatively simple, straightforward and valuable method of estimating predictive efficiency of a test. Estimates are based upon the calculated probabilities that an individual who has a given test score will achieve, a specified score or rating in the performance being predicted."[2]

This is an easy and reliable approach of finding out the relationship, if any, and also the direction (positive or negative) of this relationship.

It is desirable that expectancy tables should be developed on the basis of a large number of cases. As that was not true in this particular case, it was decided to test whether the obtained differences of the frequencies in different cells of the expectancy tables were significant or not, with the help of chi-square test.[3]

Predictor Test Battery

The predictor test battery consisted of six objective tests of the multiple choice type.

*Psychometry unit, Indian Statistical Institute, Calcutta.

[1]Chatterji, S & Mukerjee, M : Validity Study of a Selection Test Battery for Selecting Students at the Indian Institute of Management, Calcutta (mimeographed, 1969).

[2]Freeman, F. S.: 'Theory and Practice of Psychological Testing' – Holt Rinehart & Winston, N.Y. 1962

[3]Garrett, H.E: 'Statistics in Psychology and Education'—Vakils Feffer & Simons Pvt. Ltd., Bombay, 1967

(a) *Mathematical Comprehension*: There were 25 questions in this test and the time allowed was 60 minutes, and the knowledge required for answering was at the higher secondary level of study. The Kuder-Richardson reliability for this test is 0.82.

(b) *General Knowledge*: There were 38 questions and the time allowed was 30 minutes. Questions were based on political situations, current scientific development, and knowledge of geography, biology, physics and history. Reliability coefficient was 0.59.

(c) *English Knowledge and Comprehension*: The total number of questions in this test was 66 and the time allowed was 60 minutes. Three long passages were given and questions based on these passages were presented afterwards. The purpose of this test was to assess the capacity of the candidate to comprehend matter presented in simple English. Items of the sentence completion type, synonym antonym type, etc., were also included in this test.

(d) *Quantitative Reasoning*: The test included questions on arithmetic series completion, following direction, simple arithmetical pro-

blems etc. There were 30 questions and the time limit was 25 minutes. The reliability of this test was 0.74.

(e) *Verbal Reasoning*: There were 24 questions which were to be answered in 20 minutes. Similarities, opposites, logical reasoning and other types of items usually included in Verbal Reasoning tests were presented. The Kudar-Richardson reliability was 0.58.

(f) *Graph & Table Reading*: There were 29 questions in this test which were to be answered within 60 minutes. The candidates were required to interpret data presented in tabular and graphical form and to answer questions based on these graphs and tables. The reliability was found to be 0.70.

As the tests were of the multiple choice type, correction for guessing using the right and the omission scores, was utilised. The sample consisted of applicants to a management course, and this validity study was based on the group selected, who had completed the course. To obtain some idea as to the suitability of this test for this group the mean and standard deviation values were calculated and these values are presented in Table 1.

Table 1

Showing the mean, standard deviations, reliability coefficients, maximum possible scores and the time allowed for the tests included in the selection battery (N = 200)

TEST	Mean	Standard Deviation	Reliability	Maximum Poss. score	Time
Mathematical Comprehension	16.47	5.12	.82	25	60 minutes
General Knowledge	19.92	4.70	.59	38	30 minutes
Eng. Know. & Comprehension	31.17	8.15	.78	66	60 minutes
Quantitative Reasoning	14.77	5.13	.74	30	25 minutes
Verbal Reasoning	11.19	3.67	.58	24	20 minutes
Graph & Table Reading	10.09	4.50	.70	29	60 minutes

Criterion Used

The course covers the following 14 subjects: (A) Mathematics of Management System (B) Statistics (C) Economics (D) Indian Legal System (E) Behavioural Sciences in Management (F) Organisation and Administration (G) Finance and Financial Accounting (H) Operational Research (I) Marketing (J) Management Accounting (K) Production Management (L) Personnel and Union Management Relations (M) Management Policy (N) Business and Government. Usually different subjects are taught in different terms of the course but there are more than one paper spread over more than one term for the following four subjects viz., Mathematics, Statistics, Economics and Management Policy. The grades earned in the examination range between 1 to 9.

The entire course is divided into six terms and at the end of each term there is a written examination.

Analysis of the Data

As stated earlier the selection tests were administered on a group of applicants for admission to this course in management, and out of about 1000 applicants 60 were ultimately selected. Out of these 60 admitted to the course, 52 students completed the course and as such this study is based on these 52 candidates only.

As a pre-requisite for developing the expectancy tables, the scores obtained by these candidates in the six selection tests and the 14 criterion subjects were tabulated and on the basis of the

obtained scores the candidates were grouped into High (upper 50%) and Low (lower 50%) groups separately for the six selection test scores and 14 criterion marks. For each of the six selection tests an expectancy table was developed against each of the criterion scores in the following way: the candidates were grouped, as already stated, into High and Low groups with respect to each of the scores. Among those who were in the High group on the basis of the 1st selection test (Mathematical Comprehension) the frequency of students in the High group and also that in the Low group on the basis of the 1st criterion score (Mathematics in Management System) were obtained. Similar procedure was followed with respect to the Low group on the basis of the selection test score by plotting the frequencies into a 2×2 table. This was done for the remaining combinations of the selection tests and subjects taught, which yielded 84 (2×2) tables.

In order to examine the independence of the two way classifications of the 84 (2×2) contingency tables, the usual chi-square tests with Yates correction for continuity was carried out, the formula used being as follows:

$$x^2 = \frac{N\,[(AD-BC)-N/2]^2}{(A+B)\,(C+D)\,(A+C)\,(B+D)}$$

where A and B stand for the frequencies of the first two-row cells, and C and D stand for those of the second two-row cells. The obtained x^2 values are presented in Table 2. Next, these frequencies were converted into percentages and these are presented in Table 3.

Table 2---Showing the chi-square values of the 84 contingency tables

Subjects	MC	GK	EKC	QR	VR	GTR
Mathematics of Management	7.65**	0.08	0.08	0.37	0.00	0.08
Statistics	2.72	1.93	0.08	2.72	11.02**	1.10
Economics	1.16	2.03	0.08	0.25	0.25	0.73
Indian Legal System	0.00	0.08	0.70	0.00	0.29	0.08
Behavioural Sciences	0.00	0.08	3.98*	0.25	7.77**	0.73
Organisation & Administration	0.11	0.31	1.38	0.05	3.71	0.32
Finance & Fin. Accounting	0.27	6.38*	0.79	0.37	0.27	0.08
Operational Research	0.62	5.59*	0.03	0.04	3.87*	0.35
Marketing	0.89	0.00	0.33	0.13	0.0-	0.00
Management Accounting	0.27	0.08	6.38*	0.00	4.86*	1.99
Production Management	0.62	0.03	0.00	0.16	0.62	1.40
Personnel and Union Management	0.62	0.00	0.37	0.62	4.06*	0.00
Management Policy	0.76	0.00	0.35	0.65	0.10	1.25
Business & Govenment	0.04	0.00	0.33	0.62	0.04	2.99

* indicates significant at 5% level   ** indicates significant at 1% level.

Table 3

Showing the percentages of High and Low scoring students in different subjects taught in the course in the High & Low scoring groups on the basis of selection tests

Subjects		M C		G K		E K C		Q R		V R		G T R	
		H	L	H	L	H	L	H	L	H	L	H	L
Mathematics of Management	H	64	22	38	46	42	42	36	48	44	41	46	38
	L	36	78	62	54	58	58	64	52	56	59	54	62
Statistics	H	60	33	35	58	50	42	60	33	72	22	54	38
	L	40	67	65	42	50	58	40	67	28	78	46	62
Economics	H	48	30	27	50	42	35	44	33	44	33	31	46
	L	52	70	73	50	58	65	56	67	56	67	69	54
Indian Legal System	H	44	48	46	46	54	38	44	48	52	41	46	46
	L	56	52	54	54	46	62	56	52	48	59	54	54
Behavioural Sciences	H	40	37	35	42	54	23	44	33	60	19	46	31
	L	60	63	65	58	46	77	56	67	40	81	54	69
Organisation & Admn.	H	36	44	46	35	50	31	44	37	56	26	35	46
	L	64	56	54	65	50	69	56	63	44	74	65	54
Finance and Fin. Accounting	H	48	37	23	62	42	42	36	48	48	37	46	38
	L	52	63	77	38	58	58	64	52	52	62	54	62
Operational Research	H	40	26	15	50	38	27	32	33	48	19	38	27
	L	60	74	85	50	62	73	68	67	52	81	62	73
Marketing	H	28	44	38	35	31	42	32	41	36	37	38	35
	L	72	56	62	65	69	58	68	59	64	63	62	65
Management Accounting	H	48	37	46	38	62	23	40	36	60	26	54	31
	L	52	63	54	62	38	77	60	64	40	74	46	69
Product Management	H	40	26	27	38	31	35	28	37	40	26	42	23
	L	60	74	73	62	69	65	72	63	60	74	58	77
Personnel & Union Management	H	36	22	31	27	35	23	36	22	44	15	31	27
	L	64	78	69	73	65	77	64	78	56	85	69	73
Management Policy	H	36	52	42	46	38	50	52	37	40	48	35	54
	L	64	48	58	54	62	50	48	63	60	52	65	46
Business & Govt.	H	36	37	34	38	31	42	44	30	40	33	23	50
	L	64	63	66	62	69	58	56	70	60	67	77	50

As for the criterion tests, the maximum possible score was 9, the range of the obtained scores was quite narrow and the scores clustered around the median values. Hence grouping the students into High and Low categories could not be accomplished always in two equal halves, but in case of predictor tests, the problem was not so acute.

From Tables 2 and 3, it is observed that high and significant positive relations existed between the following pairs:

(i) Mathematical Comprehension and Mathematics of Management System

(ii) English Knowledge and Comprehension and Behavioural Sciences in Management

(iii) English Knowledge and Comprehension and Management Accounting

(iv) Verbal Reasoning was highly and significantly related to many of the subjects taught in the course viz., Statistics, Behavioural Sciences in Management, Operational Research, Management Accounting, Personnel and Union-Management Relations.

Moderate (but not significant at the 5% level) positive relations were observed between

(i) Mathematical Comprehension and Statistics

(ii) Quantitative Reasoning and Behavioural Sciences in Management

(iii) Quantitative Reasoning and Organisation and Administration

(iv) Graph & Table Reading and Business & Government.

High negative (significant) relations were observed between General Knowledge and Finance and Financial Accounting, General Knowledge and Operational Research. Out of the six predictor tests Verbal Reasoning had most of the positive relations with the criterion marks.

It was further observed that for some of the selection tests, the High scoring group had unequal percentages (the difference between two percentages being quite high) of being in the High and Low groups on the basis of scores on some of the subjects taught in the course, yet in the corresponding Low group these two percentages were very close to one another in the two groups mentioned above. Similarly this difference in percentages in High and Low groups on the basis of some of the subjects was high for the Low group on the basis of selection tests, whereas, for the corresponding High group, such high value of the difference in the corresponding two percentages was not observed. Examples of such cases are the percentage distributions of

(i) G T R in High & Low groups in Business & Government

(ii) E K C in High & Low groups in Organisation and Administration

(iii) Mathematical Comprehension in High and Low groups in Economics etc.

Such selection tests were able to discriminate the High scoring (on the basis of the criterion subjects) students from the Low scoring one only either at high score (on the basis of selection tests) level or at Low score level.

It is also proved that there were many subjects which were not at all related with any one of the selection tests, i.e., Management Policy, Indian Legal System, Marketing, Production Management. Hence some additional tests should be included in the battery so that such tests can predict the success in these subjects. The syllabus of the subjects should be carefully studied to develop such tests, and also some experiments with different types of aptitude should be conducted and only those tests which can be proved to be valid in this respect may be included in the battery. ●●●

Atomic Power of Prayer

"Today's scientists are discovering what we preacher's kids knew all along, that you don't have to understand all about either an atom or a prayer to harness its power."

—'Preacher's Kids' by Grace Fletcher

Critical Path Method
and
The Consultant Engineer

G.K. Ahuja*

Of the newer tools for decision making, the Critical Path Method (CPM) has become particularly popular with the American Consultant-Engineer, and wherever it has been used, the results have been rewarding. The Consultant Engineer gets a two-fold advantage from the Critical Path Method. Firstly, CPM optimises the activities of his own consultancy resources, taking into consideration the aggregate of his client's requirements; secondly, it optimises the working of each client's project according to the conditions obtaining from time to time. The subject may be divided into three parts : (a) Optimisation in the office of the Consultant Engineer, (b) Optimisation during the Erection of the plant, (c) Use of Electronic Computer in solving the complex problems. In this article, the author discusses only the first part, viz., Optimisation of the Consultant Engineer's own resources, after a brief exposition of what the CPM is.

CPM INTEGRATES ALL THE FACTORS OF A project: time, money, material and manpower, and provides an optimum time-cost relationship. It develops a pictorial representation of the project with a closed network of arrows, joined head to tail. The network so developed depicts the interlink between the various activities. The arrow pinpoints a certain activity while the point where the arrowhead and the tail meet indicates the event in time. The duration of the entire project can thus be estimated by assigning the time durations to each activity and summing up as shown in steps 2 and 7.†

To reduce project duration, CPM indicates the possibilities of compression, in point of time, the activities on the Critical Path, being the longest in point of time, taking care to see that there is the smallest change in cost per unit time, as crashing the normal duration of the project tends to increase

its cost. CPM is thus an instrument for minimising the aggregate project cost; at the same time it facilitates completion of the project in the shortest desirable time.

Generally the number of activities in a big project is so large that it necessitates the use of Digital Computer while solving the network. To assist in the Computer Programming the CPM model has been illustrated step by step, by a numerical-hypothetical problem.

A consultancy Bureau, retained by a client to prepare a detailed project report is required to expedite the project to an earlier date, as against the time-schedule suggested by the consultants. The client wants to save time; and the more he wants to save, the greater the cost the consultant engineer has to incur to help his client in economising time. Naturally a point comes where the additional cost of the consulting engineer balances the savings of the client on account of time gained. It would be helpful, if a graph of increase in charges *vs* the reduction in time is drawn up.

*Design Engineer, Technological Consultancy Bureau, National Industrial Development Corporation, New Delhi.

For the sake of simplicity, a network consisting of a comparatively small number of activities is taken up; and the network representation of the hypothetical project consisting of the activities of the office of the Consultant Engineer is drawn. The complete network of activities is shown in Fig. 1. Event 1 represents the start, while event 14 indicates the completion of the work by the consultants. Each activity is represented as $\dfrac{x,y}{w}$, where the direction $\rightarrow$ of the arrowhead shows the direction of movement of the activity between the two events; x is the crash time (the smallest time in which the activity could be finished); y is the normal duration and w is the average incremental change in cost per unit time saved[1]. The

NET WORK REPRESENTATION
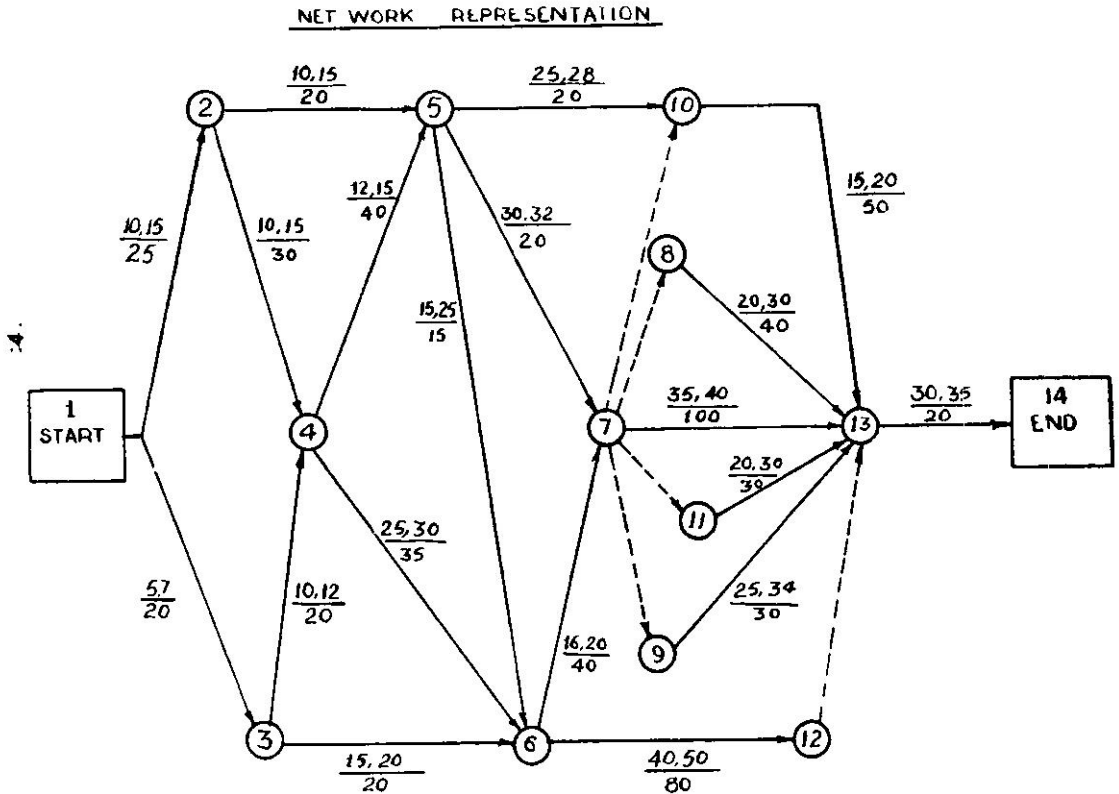
Fig. 1

<hr/>

1. The value of w varies with the amount of time saved. If the crash time is x, and the normal time is x_n, then for the time durations $x_1, x_2, \ldots - x_n$ the increase in cost (w) would be $w_1, w_2, \ldots w_n$ respectively (Here w_n is zero, because the time duration x_n being normal time needs no crash). To simplify the calculations, an average of $w_1, w_2 \ldots w_{n-}$ is taken and named w. This would mean that for a crash in an activity by m units, the cost would be mw units plus the amount required for normal time duration.

description of activities* in Fig. 1 is as follows:

Activity	Description
1- 2	Analyse the system
1- 3	Divide the work
2- 4	Do market survey
3- 4	Study resources
2- 5	Locate site
3- 6	Do preliminary project estimations
4- 5	Fix raw materials
4- 6	Fix production mix
5- 6	Work on development of site
5- 7	Do preliminary work on Utilities
5-10	Work for imports & exports
6- 7	Estimate manpower and machine requirements
6-12	Prepare design and drawings for civil works
7- 8	Dummy
7- 9	Dummy
7-10	Dummy
7-11	Dummy
12-13	Dummy
7-13	Design Utilities
8-13	Prepare specifications of machines
11-13	Estimate Selling price
9-13	Estimate profitability
10-13	Prepare equipment layout
13-14	Prepare project report

After proper representation of the problems the undermentioned steps are followed.

STEP 1: The crash times X_k (where $k = 1, 2 \ldots n$, n being the number of activities) of all the activities are put equal to T_k and are indicated on the network as shown in Fig. 2.

STEP 2: A value Z_1 is assigned to each event with Z_1 as the longest crash time duration between event i and event 1. (Fig. 2.)..$Z_{14} = 128$.

STEP 3: The critical path (for crash times) through the entire project is determined and marked in thick line (Fig. 2).

STEP 4: The redundant elements (out of the non-critical elements) of the network are determined as given in Table I.

TABLE 1

S. No.	Events i, j	Path under test i..a..m..j	Zji (zj-zi)	y' ij (yia+yab +..+ymj)	(zji-y' ij) (+ve. −ve)	If redundant[2] (yes or No)	Redundant Elements
1[3]	1,4	1-3-4	20	19	+	Yes	1-3, 3-4
2	2,5	2-5	22	15	+	Yes	2-5
3	3,6	3-6	42	20	+	Yes	3-6
4	4,6	4-6	27	30	—	No	—
5	5,7	5-7	31	32	—	No	—
6	5,10	5-10	31	28	+	Yes	5-10
7	6,13	6-12-13	51	50	+	Yes	6-12, 12-13
8	7,13	7- 8-13	35	30	+	Yes	7-8, 8-13
9	7,13	7- 9-13	35	34	+	Yes	7-9, 9-13
10	7,13	7-10-13	35	20	+	Yes	7-10, 10-13
11	7,13	7-11-13	35	30	+	Yes	7-11, 11-13

2. The path elements are redundant if $(zji-y'ij)$ is +ve.
3. For path 1-3-4, $zji = z_4 - z_1 = 20$; $y'ij = y'_{14} = $ normal time duration for (1-3) + normal time duration for (3-4) i.e. $7+12 = 19$. Thus $z_{41} - y'_{14} = 20 - 19 = +1$; So paths 1-3 and 3-4 are redundant.

*It is assumed that the persons in each activity are experts in the field, with no margin for interchangeability.
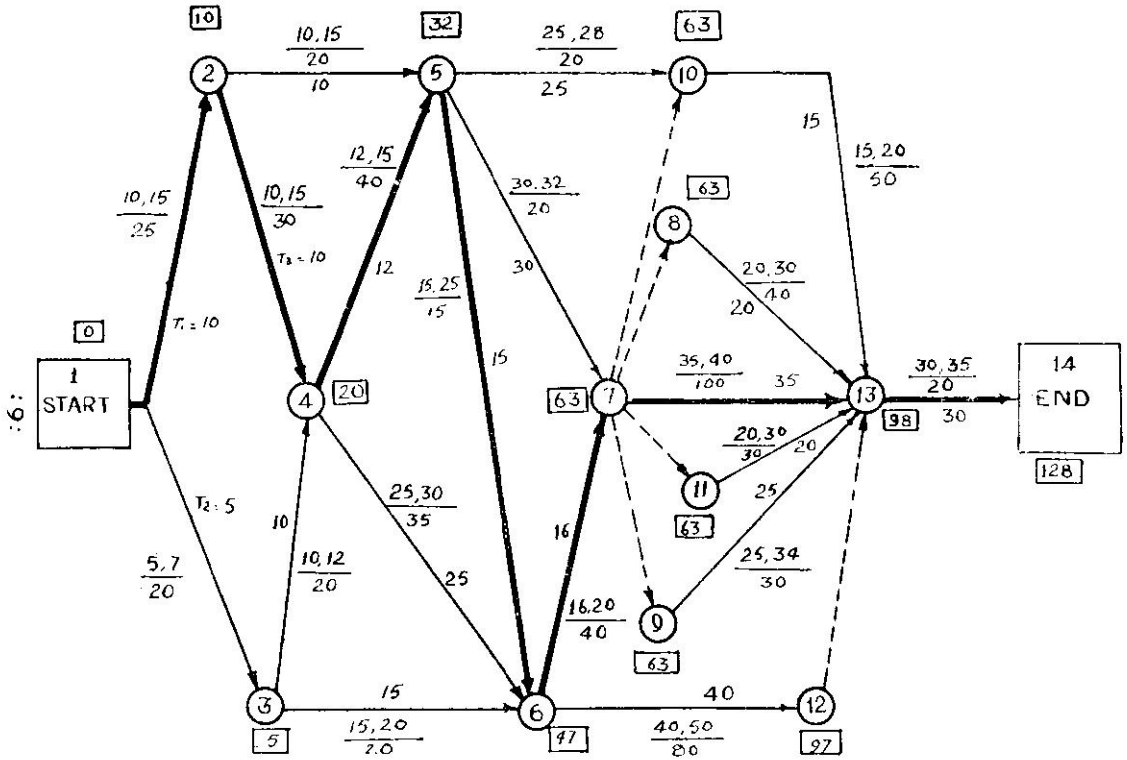
FIG. 2

STEP 5: The redundant elements are eliminated from the network (Fig. 3). The network now contains the critical and sub-critical elements. The elements are sub-critical if (i) they are not critical, and (ii) they are not redundant.

STEP 6: T_1 is now made equal to y_1, the normal time durations as shown in Fig. 3.

STEP 7: Z_1 of the events are now calculated and marked according to the normal time durations (Fig. 3) $Z_{14}=165$.

STEP 8: Critical Path is determined and marked in thick line (Fig. 3).

STEP 9: The sub-critical elements are noted; these are: 4-6 and 5-7.

STEP *10-15* Are repeatedly followed till no further sub-critical paths are found.

STEP 10: The elements forming cut-sets[4] with the sub-critical elements are determined.

4. When we make a cut in the network, so that the whole network is entirely divided into two definitive and exclusive parts, we say that a cut-set is formed. For instance, the cut A as shown in the adjoining figure forms a cut-set while the cut B does not do so. The elements of the cut-set formed by A are 1-3, 1-4, and 2-4.
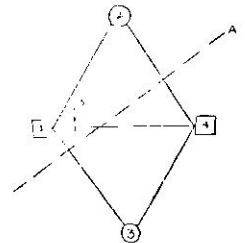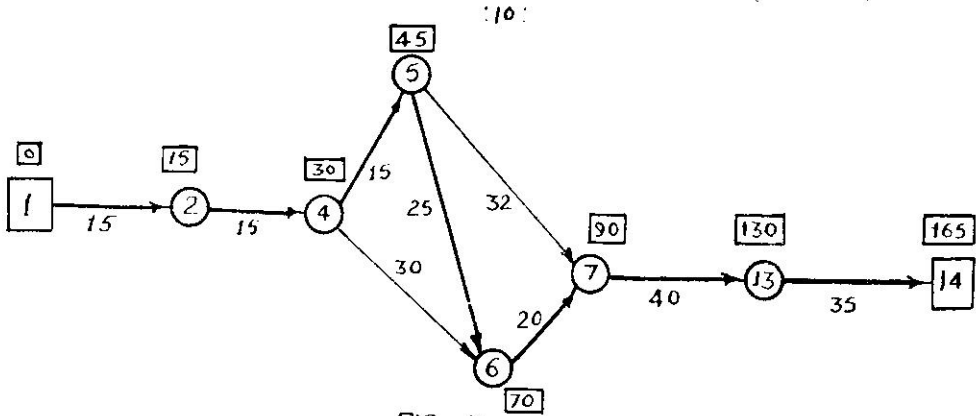
FIG. 3
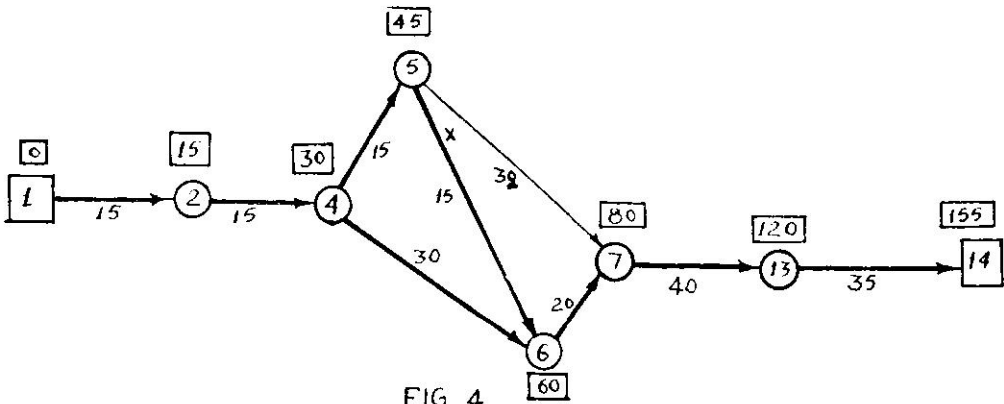
FIG 4
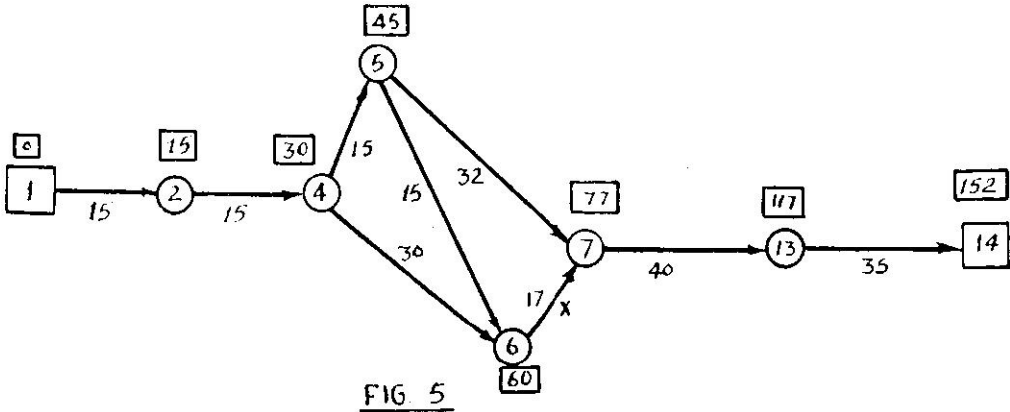
FIG 5

The cut-sets so determined contain the following sets of elements. (1) 4-5, 4-6, (2) 4-6, 5-6, 5-7, and (3) 5-7, 6-7. The critical elements in each are 4-5, 5-6, and 6-7, having W as 40,15 and 40 respectively. The value of W is minimum for 5-6 which is therefore taken first, for compression (Crash).

STEP 11 : $Zji - Y'ij$ (from fig. 3) for the sub-critical elements of the cut-set is determined below (the calculations are similar to the calculations in Table 1).

Path 4-6 (i.e. i:4, j:6) **Path 5-7** (i.e. i:5, j:7)

$$Zji = Z_{64} \qquad\qquad Zji = Z_{75}$$
$$= Z_6 - Z_4 \qquad\quad = Z_7 - Z_5$$
$$= 70 - 30 \qquad\quad = 90 - 45$$
$$= 40 \qquad\qquad\quad = 45$$
$$Y'ij = Y'4,6 \qquad\quad Y'ij = Y'5,7$$
$$= 30 \qquad\qquad\quad = 32$$
$$Zji - Y'ij = 40 - 30 \quad Zji - Y'ij = 45 - 32$$
$$= 10 \qquad\qquad\quad = 13$$

STEP 12: Minimum of $(Zji - Y'ij)$ for the sub-critical paths is determined: i.e. Min $(10, 13) = 10 = P$(say)

STEP 13: Critical element in question, i.e., 5-6 could be crashed by $y-x = 25 = 15$
$$= 10$$
$$= Q \text{ (say)}$$

STEP 14: Minimum of P & Q is the amount of crash to be effected. Min $(10, 10) = 10$

$\therefore$ 5-6 is crashed by 10 Units

or   crash $d = 10$.

STEP 15: The crash according to step 14 is indicated in the network and a fresh figure is drawn. (Fig. 4)[5]. We find that 4-6 has become critical while 5-7 still remains to be sub-critical. In that event we repeat the process from step 10 onwards till the network becomes critical. To be specific we re-start from step 10 and

designate the steps 10-15 with an extra letter "A" like step "10(A)", "11(A)", etc.

STEP 10 (A): According to step 10, the next critical element to be crashed is 6-7, which is now taken up.

STEP 11 (A): For the sub-critical element 5-7 find $Zji - Y'ij$.

$$Zji = Z_{75}$$
$$= 35$$
$$Y'_{ij} = 32$$
$$Z_{ij} - Y'_{ij} = 35 - 32$$
$$= 3$$

STEP 12 (A): Min $(Z_{ji} - Y'_{ij}) = 3 = P$

STEP 13 (A):

$$Q6-7 = 20 - 16$$
$$= 4$$
$$= Q$$

STEP 14 (A):

Minimum $(P, Q) = $ Min. $(3,4)$
$$= 3$$

$\therefore$ 6-7 is crashed by 3 units as shown in Fig. 5.

STEP 15 (A): Network now contains all critical paths and thus we go to step 16.

STEP 16: Considering the various cut-sets, the critical outset table is drawn up.

STEP 17 : Compress (crash) the activities according to the order given in Table 2.

1. 13—14 could be crashed by an amount $y - x = 5$

   $\therefore$ $d = 5$ ....Fig. 6

2. 1-2 could be crashed by 5 units

   $\therefore$ $d = 5$......Fig. 7

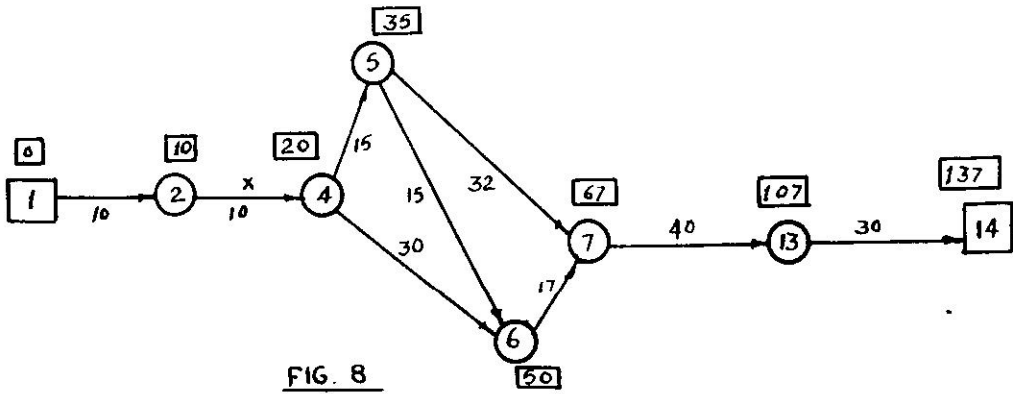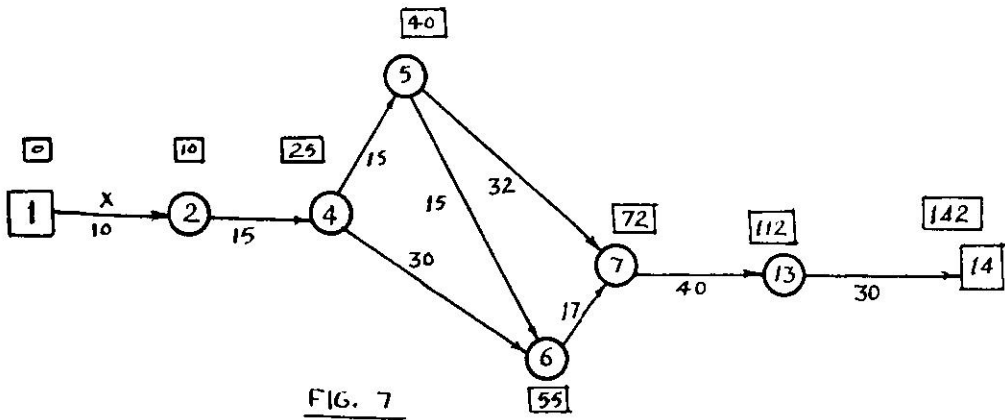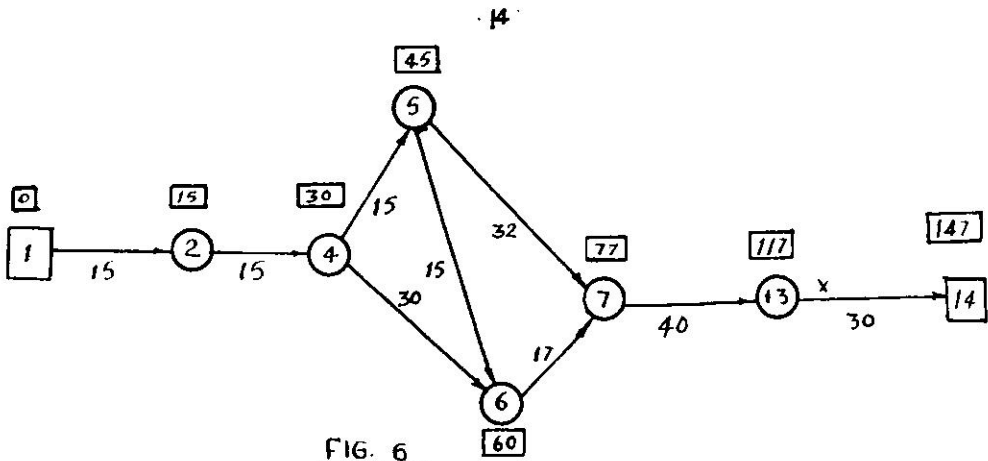5 Crashed elements are marked by x in the corresponding figures.

FIG. 6

FIG. 7

FIG. 8

TABLE 2

S.No.	Elements of cut-set	Weight of cut-set w'	Sequence in which compression to be effected
1	2	3	4
1.	1—2	25+ 0 = 25	2
2.	2—4	30+ 0 = 30	3
3.	4—5, 4—6	40+35 = 75	6
4.	4-6, 5-6, 5-7	35+15+20 = 70	5
5.*	4-5, 5-6, 6-7	40—15+40 = 65	4
6.	7—13	100+ 0 =100	7
7.	13—14	20+ 0 = 20	1

*5—6 is in the opposite direction

3. 2-4 could be crashed by 5 units.

    ∴ $d=5$........Fig. 8

4. 4-5, 5-6 and 6-7 are not in the same direction. 4-5 and 6-7 are in the positive direction while 5-6 is in the negative direction. Thus if 4-5 & 6-7 are compressed, 5-6 should be expanded to main tain the criticality of the cut-set. We find that by compression in 4-5 & 6-7 with an expansion in 5-6, there is a compression in the total duration of the cut-set. Now 4-5 & 6-7 could be crashed by 3 and 1 respectively, while 5-6 could be expanded by 5 units. The minimum of the three is 1.

Thus $d=1$, which means that 4-5, & 6-7 are crashed by 1, while 5-6 is expanded by 1......Fig. 9.

5. 4-6, 5-6 & 5-7 are in the same direction and can be compressed by 5, 1 & 2 respectively.

    ∴ $d=1$......Fig. 10

6. 4-5, 4-6 could be compressed by 2 & 1 respectively

    ∴ $d=2$........Fig. 11

7. 7-13 could be compressed by 5 units
    ∴ $d=5$........Fig. 11.

Time-Reduction Table

TABLE 3

| S.No.	Path Element cost per unit time saved	Increment in cost per unit time saved	Effective crash	Increase in cost	Total crash	Length of the critical path	Total increase in cost	Remarks
1	—	—	—	—	—	165	—	—
2	5—6	15	10	150	10	155	150	STEP 14
3	13—14	20	5	100	15	150	250	,, 17.1
4	1—2	25	5	125	20	145	375	,, 17.2
5	2—4	30	5	150	25	140	525	,. 17.3
6	6—7	40	3	120	28	137	645	,, 14(A)
7	4-5, 5—6 6 —7	65	1	65	29	136	710	,, 17.4
8	4-6, 5-6, 5—7	70	1	70	30	135	780	,, 17.5
9	4-5, 4-6	75	2	150	32	133	930	,, 17.6
10	7—13	100	5	500	37	128	1430	,, 17.7
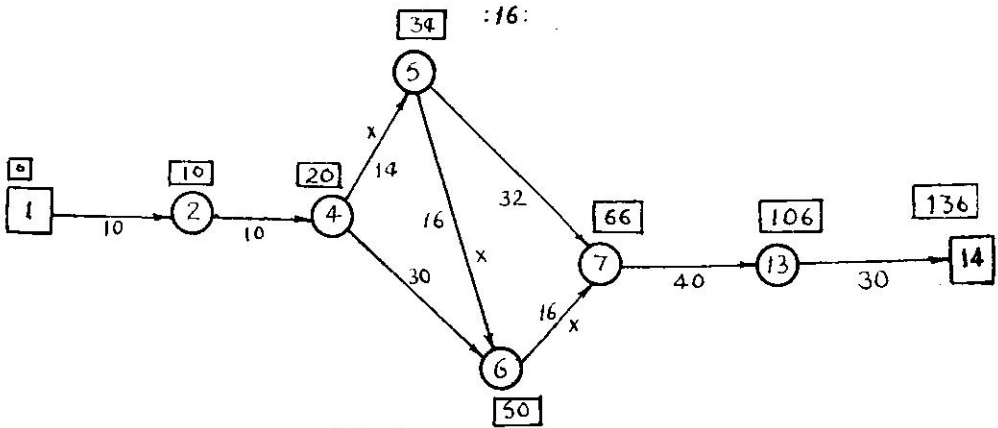
FIG 9
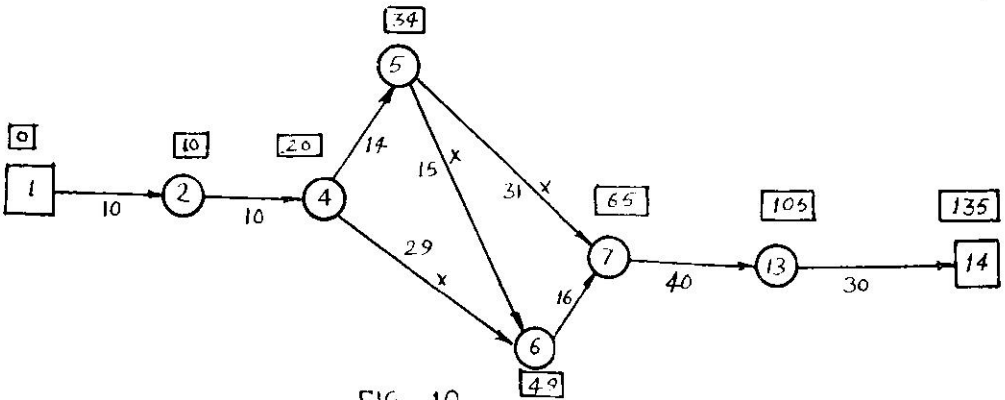
FIG. 10
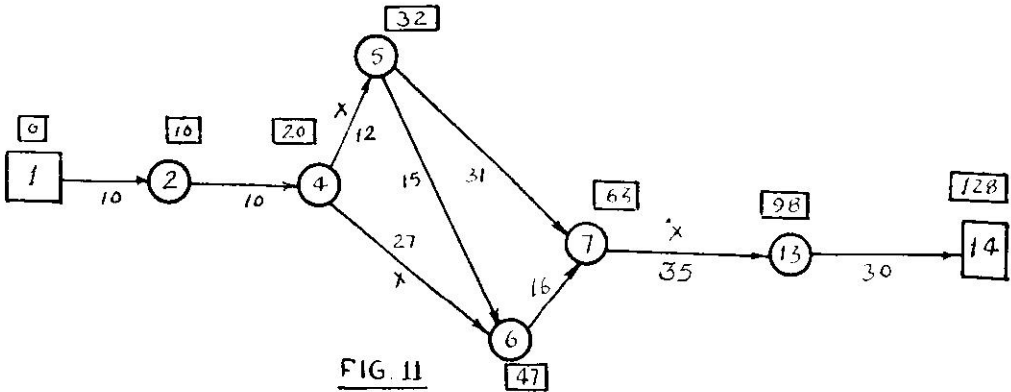
FIG. 11

: 19 :

PROJECT- COST CURVE

FIG. 12
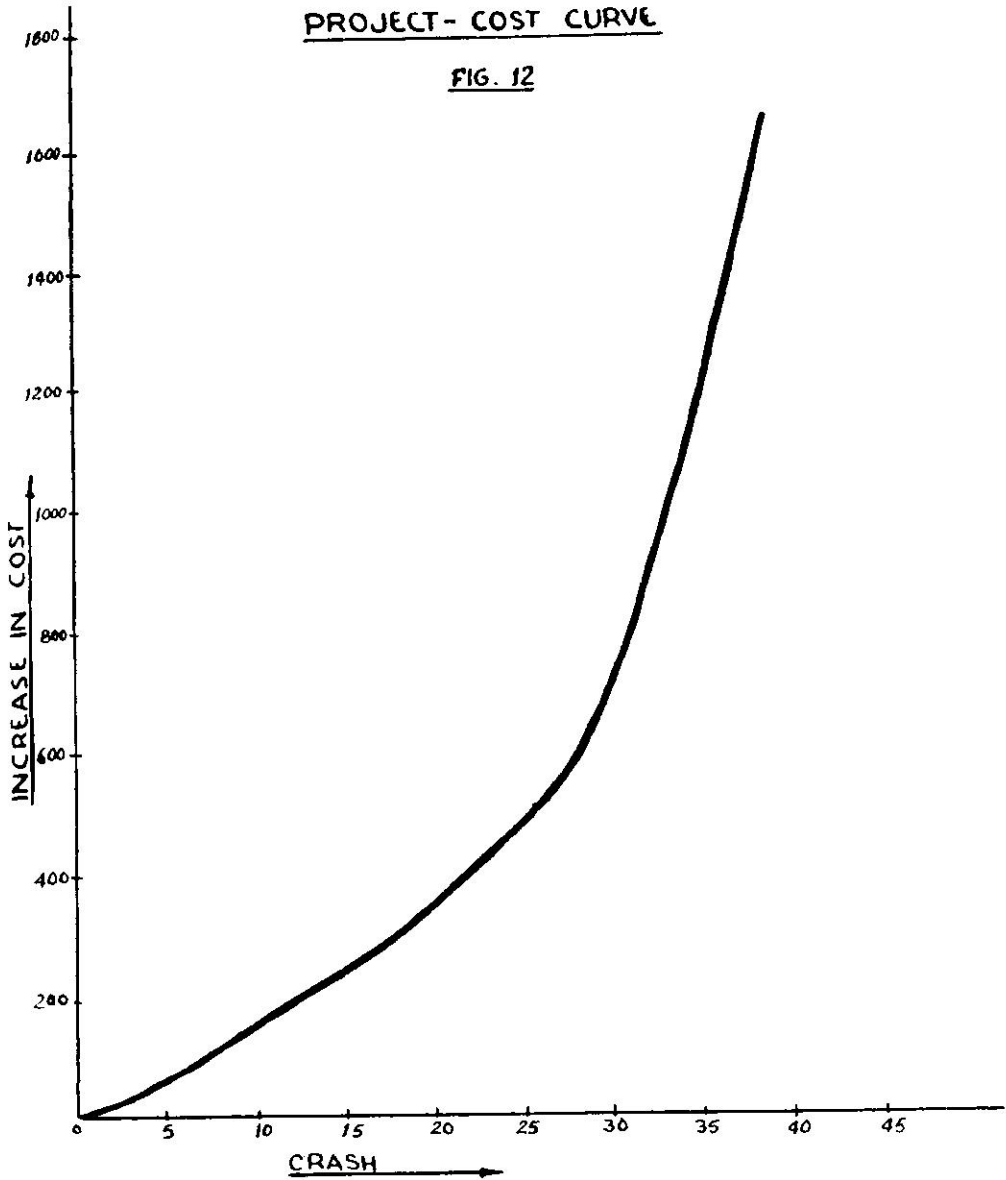
Thus all possible crashes have been made and the total time has been reduced from the normal duration of 165 units to the crash duration of 128 units.

STEP 18: A time-reduction table is now prepared (as given in Table 3), starting with the lowest increase in cost per unit time saved and ending up with the highest one.

STEP 20: Using the time reduction table (Table 3), draw a project-cost curve as shown in Fig. 12.

STEP 21: As the relationship between the compression and the increase in cost is known, we can easily decide upon the total compression to be effected according to the client's requirements. Looking back at Table 3, we can decide upon the activities to be crashed and the amount by which each such activity should be crashed.

For example, if we decide to spend 710 more units, the project duration could be reduced by 29 units and the activities to be crashed would be 5-6, 6-7, 13-14, 1-2, 2-4, 4-5, 5-6, & 6-7 by an amount 10, 3, 5, 5, 5,—1 and 1 respectively, where (—) sign represents an expansion. We thus have the compression in the following activities.

Activity	Amount of Compression
5-6	9
6-7	4
13-14	5
1-2	5
2-4	5
4-5	1

The final network (with redundant elements eliminated) would be as shown in Fig. 9. The project duration is now 136 units of time, as compared to 165 units, the normal time duration of the Project. ●●●

〜〜〜〜〜

... **Making a religion of work only can work when you have religion to begin with.**

... **The gospel of work is not only unattractive but almost certainly inefficient in the promotion of industrial efficiency—its supposed object—because it fails to understand that working people want more from their jobs than mere high wages. In his presidential address to the TUC, Mr. John Newton came much closer to the real problem.**

> **Where work gives little or no satisfaction to the worker, where there is no freedom to exercise their skill, where men and women do not determine how they do their work, where they have become merely components in the production system, they have, during their working lives, lost their identity as individuals. Underlying many strikes is a protest against an unnatural environment.**

This is undoubtedly true. Where work gives no reward other than a wage-packet, a strike is often a form of holiday, or rather escape, from a burdensome and monotonous existence. The phenomenon is universal in advanced industrial societies : even where unofficial strikes are rare, as in West Germany, it takes the form of absenteeism.

... **We know how to make a factory more efficient : can we make it a better place to work in ? One thing we are clear about : the British electorate has had its fill of sermons.**

O R at Safdarjang Hospital

TN Kuppuswami*

The author, who is Administrative Officer of the famous Safdarjang Hospital, New Delhi (known as the American Hospital in war-time), has made Operational Research Studies, relating to the Business Services, incidental to the running of the Hospital; for these are the areas—not surely the essential hospital services—in which economies could be practised with maximum advantage to everybody concerned, including the Government. Further, in India, at the present stage of development, manpower economies can hardly be effected so that items affecting personnel, their salaries and wages are sacrosanct. Economies can only be effected in diet planning, inventories of medicines and other stores, utilisation of X-ray and other machines, hospital linen, laundry etc. etc. In fact, it appears that substantial work in Systems Analysis, Method Study etc. etc. in these lines has already been done in the Hospital†. In presenting his material, the author also appears to have been anxious to demonstrate something dramatic that could really be achieved, and to publicise the application of statistical techniques to Hospital Management, a development which he claims to be unique.

THE ULTIMATE AIM OF THE STUDIES, SO FAR DONE at the Safdarjang Hospital, is to convert the conventional budget of the hospital into a performance budget equating the cost of running the hospital to the various activities like Medical, Surgical, Paediatrics, Radiology etc. This will instil cost-consciousness in the minds of the various sections of the Hospital which ultimately would lead to all-round economies.

Increasing budgetary demands as shown in Table I have necessitated thinking of drastic economies in all spheres. The most vulnerable area for this purpose appeared to be the business side. The business side of a hospital is defined to include varied fields of activity. It not only includes store purchases but also the utilisation of stores and equipment and men and material. Economy could not be thought of in wages and salaries or in the working personnel, as this would attract the attention of aggressive Trade Unions and would meet with positive resistance resulting in undesirable consequences in developing countries like India. Areas which would yield dramatic, gainful but peaceful results were earmarked. Only the major projects undertaken

*Administrative Officer, Safdarjang Hospital, New Delhi.

†See References

in the Safdarjang Hospital are discussed here for want of space.

TABLE I

Budget of Safdarjang Hospital

Year	Rupees	In US Dollars
1964—65	80,82,909	1,077,721.20
1965—66	1,04,71,685	1,396,224.70
1966—67	1,20,42,190	1,605,625.30
1967—68	1,19,95,175	1,599,356.70
1968—69	1,33,48,960	1,779,861.30

Diet Expenditure

One of the important items in hospital expenditure is the indenting, preparation and distribution of diet. We found that the indenting of diets and its supply from the Hospital Kitchen were rather crude here, resulting in waste in production as well as consumption. A study of diet planning, production and distribution was therefore undertaken. Using the technique of regression analysis, it was possible to calculate statistically the aggregate demand for diet from the wards. The number of patients at 11 A.M. on any day is found to be distributed normally with a mean equivalent to last three days' average + 50 and standard deviation 20.25. Hence on 99.7% of the days the number of patients at

11 A.M. will be less than (the last three days' average+111) This gives the basis for scheduling the number of lunch diets. The extra diet, if any, would be prepared in the kitchen.

Similarly for estimating the number of dinners, it was found that the number of net addition between midnight and 6.30 P.M. is on an average about zero with a standard deviation of 19.5. Hence the number of patients at dinner time on any day would not exceed that day's midnight census plus 58.5 (approx. 60).

Since no provision for any breakfast is made in the scales of diet authorised for patients, there is no problem for the kitchen! However the early morning bed tea and milk at 8 A.M. are given and the estimates for these items are made as for dinners.

Allocation of diets to children did not pose any special problem. Statistically estimated figures for lunch and dinner as explained above were divided in the ratio of children beds to adult beds.

The statistically analysed planning of diet has contributed not a little to the economic production and distribution of hospital diets as is evident from Table II.

TABLE II
Consumption of Diets

Sl. No.	Year	Inpatient days care according to midnight census report	Total diets issued during the year	No. of diets per patient day in %
1.	1965-66	4,16,830	4,65,344	112
2.	1967-68	4,30,652	4,45,060	104
3.	1968-69**	4,44,966	4,25,809	95

The kitchen need not wait for the indents from the wards but has to wait only for the midnight census report. This report gives the details of patient distribution in the Hospital and also serves as a broad guide for the distribution of diets; but actual distribution list of diets is prepared by the kitchen according to the

** Year when the scientific planning of diet production and distribution was introduced.

actual demand of diets received a few hours before lunch or dinner. The practice obtaining before the introduction of scientific production and distribution of Hospital diets was, however, for the kitchen to demand diet indents from the wards at least a day before the actual consumption, and the ward sisters could do this only by resorting to crystal gazing. As a consequence large quantities of diets were cooked, wasted and stolen! Table II indicates how a considerable amount of economy has been effected in this matter. The principles enunciated above are worth exploring for universal application in all large hospitals.

X-Ray Machine Utilisaion

The purpose of the study was to find out the utilisation of machines in the X-ray department to know the causes of non-utilisation, to ascertain the queue length of patients, to make the best use of the machines and to reduce the waiting time.

There are 8 X-ray rooms in the department, with varying sizes of machines. The patients were allocated to each room according to the nature of X-rays to be taken: chest, skull, spine sinus, mastoial etc. Data for the intended purpose was collected by using the snap study technique, recording the state of affairs at a particular place and time.

Average waiting time per patient is given in Table III. The waiting time is found to be as high as 32.4 minutes in the mornings and as low as 4.2 minutes in the afternoons. Though by any standard in a developing country, this waiting time in the morning is not found to be excessive, the heavy disparity between the waiting time in the morning and in the afternoon caused concern to the Radiologist. This sort of thinking is the first step in improving the service to the patient. It was found that the outpatients were mainly X-rayed in the mornings. The ingress of this crowd could not easily be controlled as there is no appointment system either in the outpatient department or in the X-ray department for this category of patients. I use the term 'crowd' to describe them because that is what it is in an overpopulated developing country. In the

afternoons, only inpatients, relatively a disciplined category, were X-rayed and they could be given appointments. Serious thought has been given to disciplining the outpatients, and to a very great extent we have succeeded by reallocating the outpatients to different timings and to different X-ray machines. This factor of waiting was found to be closely related to the non-utilisation of the machines, as explained in Table III.

TABLE III

Average Waiting Time per Patient in the X-Ray Unit

Sl. No.	Time Interval (Hrs)	Average Time (Mts)
1.	9.00 to 10.00	32.4
2.	10.00 to 11.00	26.4
3.	11.00 to 12.00	25.2
4.	12.00 to 13.00	4.2
5.	14.00 to 15.00	10.2
6.	15.00 to 16.00	6.0

Table IV shows that the non-utilisation of the X-ray machines was high in the afternoons compared to the forenoons and the causes of non-utilisation were found to be absence of patients, absence of radiographers, radiographers being otherwise busy in non-professional work, machines under repair etc. These causes are removable, and accordingly, action was taken. As a consequence the waiting time of the patient and the non-utilisation of machines were reduced considerably. The demand for more X-ray machines, more accommodation to house the machines and more personnel to operate the machines was completely silenced. Expenditure avoided is expenditure reduced.

TABLE IV

Non-Utilisation of X-ray Machines in percentage

S. No.	Time Interval (Hrs)	No patient	Radiographer Out
1.	9.00 to 10.00	0.0	25.5
2.	10.00 to 11.00	18.5	29.0
3.	11.00 to 12.00	16.5	22.7
4.	13.00 to 14.00	61.3	11.9
5.	14.00 to 15.00	22.1	35.2
6.	15.00 to 16.00	53.2	13.0

Inventory Control of Stores

Inventory Control of stores is intended to estimate the quantity of stores to be purchased and the frequency of such purchases. This has the effect of reducing unnecessary stocking. regulating the intervals of purchases, avoiding stock out and minimising clerical work. Studies were carried out in X-ray films, linen stores, shoe stores, miscellaneous items of stores of general usage and a fairly high rated consumption items of medical stores. The results were rewarding, as described below.

X-ray films: The ordering quantity of X-ray films is expressed by the following equation:

$$q = \sqrt{\frac{2 . S O}{P . i}}$$

where S is the estimated annual consumption, O is the ordering cost approximately Rs. 15/- per order which includes all direct and indirect expenses incurred while placing an order, P is the price per plate (the latest price is taken into account) and i is the inventory carrying cost i.e., cost of holding one unit of inventory over unit time. This is taken as 10% of unit price for a year. Fresh order for X-ray films is placed when the stock of X-ray films reaches a particular level and this level is expressed by the following equation:

Reorder Level = Maximum expected lead time in days × maximum expected consumption in a day.

(Lead time is the average time taken by suppliers to comply with orders)

Having found the quantity to be ordered and the frequency of the ordering intervals, what should be the average inventory stock with reference to the consumption rate of the various sizes of films? This was expressed by the following equation:

Average Inventory = Maximum lead time (in days) × (maximum consumption in a day minus average consumption in a day)

$$+ \frac{\text{Ordering Quantity}}{2}$$

The result of the study is given in Table V which makes the inventory control of X-ray films easy and routine.

TABLE V

Reorder Level and Ordering Quantity & Average Inventory

Sl. No.	Size	Reorder Level		Ordering Quantity (pkts of 25)	Average inventory expressed as percentage of present inventory
		Orwo	Agfa		
1	15×12	25	97	79	63
2	12×10	19	74	82	30
3	10×8	16	63	91	91
3	8½×6½	6	25	69	84
5	7×5	0.05	1	2	16
6	5×4	2	9	16	61
7	Dental	3	18	26	100

This inventory control procedure has reduced the present stock by about 60% there was a saving of Rs. 24,000/- (3,200 U.S. Dollars) and there was no shortage of stock at any time except the basic one, viz., lack of supply from the suppliers!

This sort of inventory control presupposes that the demand for X-ray examinations will conform to a uniform pattern of demand from doctors and patients year after year. Regression analysis would have made the study more accurate, but for want of data it could not be attempted.

Hospital Linen

Unnecessary accumulation of stock of linen, unscientific purchases, irrational criticism of the government's decision to purchase *Khadi* for Hospital linen were some of the problems which drew the attention of the author to seek Statisticians to apply their mind to find the solution.

The supplier was to be informed a year in advance regarding the articles of linen to be supplied at quarterly intervals. For finding out the quantity of linen to be replaced every quarter, the following equation was adopted:

(i) Quantity of linen to be replaced every quarter=maximum expected condemnation in a year divided by 4.

(ii) Maximum expected condemnation in a year=Average condemnation in a year +maximum expected variation in annual condemnation.

(iii) Average condemnation=Total condemnation in three years divided by 3, say X

(iv) Maximum expected variation in annual condemnation is $3\sqrt{x}$

This formula has resulted in the reduction of unnecessary accumulation of stock, scientific purchases and a saving of Rs 75,000 in respect of only 17 items. It can easily be imagined what would have been saved if this policy extended to 114 items which are in use in the hospital.

There was criticism about *Khadi*, popularised throughout India by Mahatma Gandhi, the father of the nation, that it does not last even for six months of normal wear. Is this a valid criticism? This was a question posed to the statisticians. Table VI is the answer. The criticism has been observed to be illfounded. After all *Khadi* is not so bad as it was thought to be. This discovery gains added significance this year as it is Gandhi centenary celebration year in India. Apart from this, *Khadi* has another merit. It does not attract the light fingered gentry! It is therefore recommended for the developing countries where theft of public property is a chronic disease!

TABLE VI

Average expected life of linen items

Sl.No.	Item	Expected Life in Years
1.	Apron	3.0
2.	Bed Sheet	2.0
3.	Bath Towel	3.0
4.	Coat (Patient)	3.0
5.	Coat (Child)	6.0
6.	Pyjama (Patient)	2.5
7.	Pyjama (Child)	3.5
8.	Draw Sheet	3.0
9.	Hand Towel	4.0
10.	Pillow Case	3.5

Shoe stores

The hsopital issues shoes and sandals to the domestic staff whose number is about 1,033, divided into 773 males and 260 females. To provide shoes and sandals of the right size to this huge staff was a job. Overstocking of wrong sizes of footwear and arbitrary purchases, frequent complaints of delayed issues were some of the problems to be tackled with. The statisticians who were faced with these problems tried to solve them by giving us the following equation:

The expected number of footwear required for the particular size is np. The extra number required to be bought for meeting fluctuations among different sizes is $2\sqrt{npq}$. The total number to be bought is $np+\sqrt{npq}$. Here n is the total strength of staff (male or female), p is the proportion of workers in a particular size estimated on a sampling basis and q is 1—p.

Alas! I have to admit here, the statisticians were stunned completely. The workers were in the habit of demanding sizes of footwear not to fit their own feet but those of their sons and relations or the prospective buyer of the footwear from them. This factor, the statisticians could not predict!

Consumable stores

The purchase and issue of stores in a hospital is done on a rather crude basis, which accounts for not a little of the frayed tempers of the nursing staff who demand these stores and do not get them at the right time and in the required quantity. To maintain the investments in inventories at the lowest level consistent with consumption and financial limits, to ensure proper supply of the various items to different wards and departments as and when required, to signal overstocked conditions in relation to current or future requirements, to provide summary figures to the management for control and planning purpose, to disclose slow-moving or obsolete items, a scientific inventory control of consumable stores like soap and soda, brooms and blades, det and flit, starter and socket etc. was thought of.

The two common systems of control of inventories are the cyclic system and the two bin system. The two bin system, though time-consuming and empirical, is more scientific and economical. So this system was adopted for important items and the cyclic system for less important items, importance being determined by consumption and price factors.

In the two bin system we have to find out lead time, buffer stock, reorder level and ordering quantity. Lead time has been defined above. Buffer stock is the quantity of material set apart as an insurance against the variation in demand and procurement period and is obtained by multiplying the maximum expected deviation of consumption rate from the average consumption rate with maximum expected lead time. Reorder level denotes the stock level at which fresh order is to be placed and is also expressed by the following equation:

Reorder level=Consumption rate per day multiplied by average lead time±buffer stock.

Ordering quantity is the quantity of the material for which order is to be placed and is obtained by the following equation:

$$q= K\sqrt{s} / Cu \text{ and } K = \frac{\Sigma\sqrt{s}}{\Sigma N} /Cu$$

where S denotes the annual demand for the item, Cu denotes the unit cost of the item and ΣN denotes the total number of orders for all items.

In the cyclic system, the stock position is reviewed at definite intervals of time with regard to availability, consumption rate etc. in order to place orders. This being empirical we applied to less important items of stores.

In practice, we found that the two-bin system has failed us here. Consumption could not be adequately estimated for the year and as a consequence the ordering quantity and the number of orders planned were off the mark. Further, varying lead time of erratic suppliers and their inability to supply the items ordered, added to our difficulties. Whatever the difficulties, one merit is obvious. Overstocking of stores is avoided, storage space is saved and opportunities for pilferage are lessened. Both the systems

could be made more scientific if there is a control on consumption. This we propose to tackle by formulating scales of stores per bed-day and outpatient attendance by doing material consumption/distribution study.

Drug Stores

As the purchases of 515 items of drug stores in a hospital of 1200 beds involves a financial outlay of Rs. 2 million, a study of inventory control of these items was undertaken. As many as 137 items are listed in the priced vocabulary of medical stores (PVMS). The consumption of these items though estimated scientifically or empirically could be met only from the government medical stores department which has rather rigid rules regarding placing of demands on them once a year and the supplies could be expected from them as and when they are available. So, not much could be done in this matter unless attempts are made to scientifically gear the government stores department to meet the demands of their clients promptly and completely. Our attention was therefore concentrated on the remaining items (non-PVMS) which are locally purchased. These items were classified according to their annual consumption value. It was found that 60 items were having 70% of the total annual consumption value i.e. 1.4 million rupees. The two-bin system of inventory control was adopted for this class of stores. Rigid control exercised under this system has reduced the stock level to 38% of what it was before. This is not a small achievement, considering the value of stores involved. Lock up of funds seems to be a routine feature in government transactions. This sort of study has activated the administration and made them cost-conscious.

The success of the two-bin system in the drug stores was due to (a) the curb on the consumption of drugs exercised by the doctors' prescription and the resultant controlled demand on the stores department and (b) the suppliers ability to meet their obligations within the estimated lead time. If these conditions are fulfilled in other areas of stores, this type of inventory control would become very effective.

Cost Units

Statistical ability to conserve consumption and effect economies has led to the exploration of areas (in the hospital) to locate cost units to serve as indices for administrators in their decision-making processes, in spite of the fact that costing in Hospital services is pooh-poohed by knowledgeable people on many seemingly valid grounds. The following cost units were decided upon:

Drug consumption cost per inpatient day
,,   ,,   ,,   new outpatient
,,   ,,   ,,   outpatient attendance
Diet consumption cost per inpatient day
X-ray unit cost per   inpatient day
,,   ,,   ,,   new outpatient
,,   ,,   ,,   outpatient attendance
Pathological test cost   per inpatient day
,,   ,,   ,,   new outpatient
,,   ,,   ,,   outpatient attendance
Central sterile services cost per inpatient day
,,   ,,   ,,   new outpatient
,,   ,,   ,,   outpatient attendance
Laundry service cost   per inpatient day
Surgical   ,,   ,,   inpatient day
Paediatric ,,   ,,   inpatient day
Paediatric ,,   ,,   new outpatient
Paediatric ,,   ,,   outpatient attendance

and so on to cover every service in the hospital as related to patient treatment.

These cost units were devised for two reasons: one, the unit of measurement should be related to the main items of expense demonstrating department efficiency, and the other, it should also be related to the hospital work as a whole and should provide a basis for inter-hospital comparison. Work on these lines is in progress. When it is completed, the performance of each department and the hospital as a whole can easily be measured and assessed. Thus cost consciousness will be generated and the whole budget can be converted into a performance budget which will be more effective in controlling expenditure consistent with the rising demands than the present conventional budget prepared on an empirical basis, sandwiched by subjective considerations.

Hospitals are ideally suited for introducing the performance budget which is essentially a technique of presenting operations in terms of functions, programmes, activities and projects. By means of this classification, the individual items which make up the budget are sought to be shown not only in financial terms but as far as possible in physical terms. As pointed out by the Hoover Commission in their report "…. Such an approach would focus attention upon the general character and relative importance of the work to be done or upon the service to be rendered rather than upon the things to be acquired, such as personal services, supplies, equipment and so on. These latter objects are, after all, only the means to an end. The all-important thing in budgeting is the work or the service to be accomplished, and what that work or service will cost."

Conclusion

We have undertaken these studies in Safdarjang Hospital (New Delhi) with the competent assistance of the Statistical Quality Control Unit of the Indian Statistical Institute; and the success of these studies is not a little due to them. In fact the Hospital is indebted to them for the enthusiasm they have generated in the minds not only of the Hospital authorities but also in the minds of the Government, who have accepted performance budgeting as a practical measure to assess the country's achievements and what the people have to pay for them.

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Gandhi to HG Wells

"Received your cable…. You will permit me to say you are on the wrong track. I feel sure that I can draw up a better charter of rights than you have done… But what good will it be? Who will be its guardian? If you mean propaganda or popular education, you have begun at the wrong end… Begin with a charter of Duties of Man, and I promise the rights will follow as Spring follows Winter. I write from experience. As a young man I began life by seeking to assert my rights, and soon discovered I had none—not even over my own wife. So I began by discovering and performing my duty to my wife, my children, friends, companions and society, and I find today that I have greater rights, perhaps, than any living man I know. If this is too tall a claim, then I say I do not know anyone who possesses greater rights than I."

—*The Harijan*, 13 October 1940

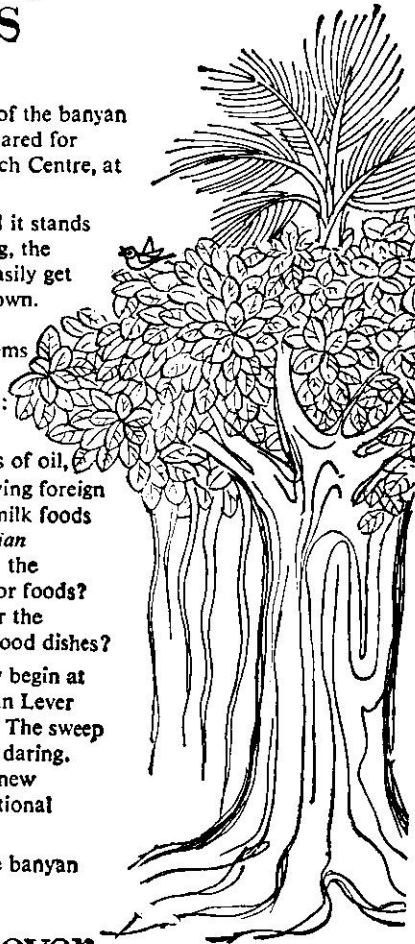# They saved the ancient banyan tree and now their daring knows no bounds

'Let it stand,' someone said of the banyan tree as the site was being cleared for the Hindustan Lever Research Centre, at Andheri.

So the tree still stands—and it stands for quite a lot. For one thing, the tree signifies that we can't easily get away from what is home-grown. Appropriately, therefore, the Centre will tackle problems rooted in India—the kind that can only be solved here:

Can we discover and exploit hitherto unused *local* sources of oil, thus cutting imports and saving foreign exchange? Can we develop milk foods that are ideally suited to *Indian* needs? How can we improve the nutritive value of protein-poor foods? Can we develop processes for the preservation of Indian type food dishes?

Research on all this can only begin at home. It has, at the Hindustan Lever Research Centre in Andheri. The sweep and thrust of the studies are daring. The scientists are producing new devices for old, making traditional things happen in new ways.

They have, of course, left the banyan tree alone to grow by itself.

Hindustan Lever

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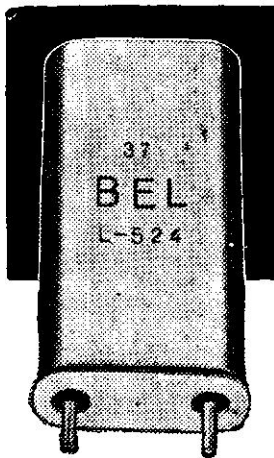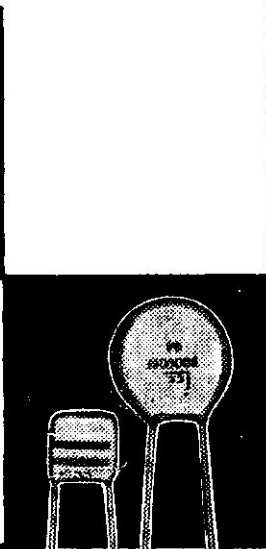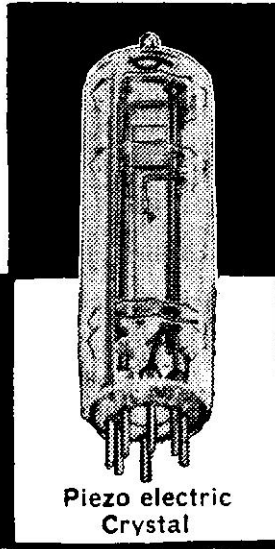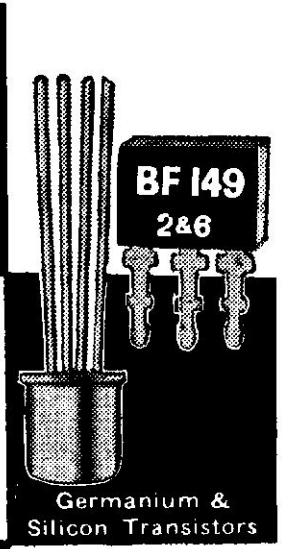
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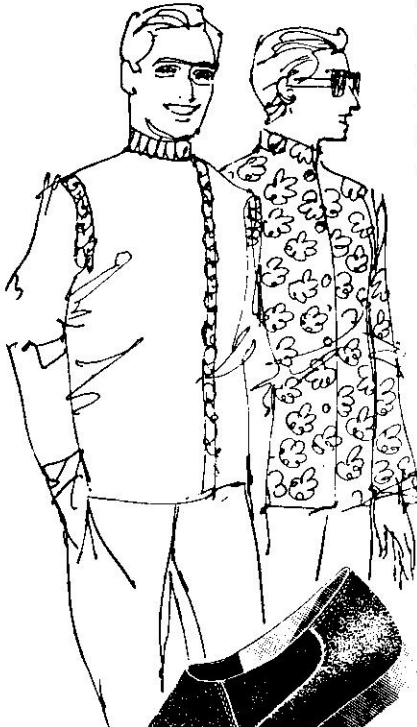Hoechst Dyes & Chemicals Ltd., Bombay-1
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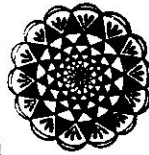*Imperon is the Registered Trademark of Farbwerke Hoechst AG.

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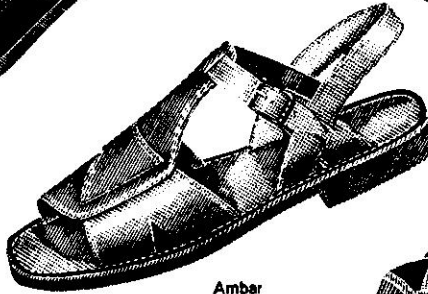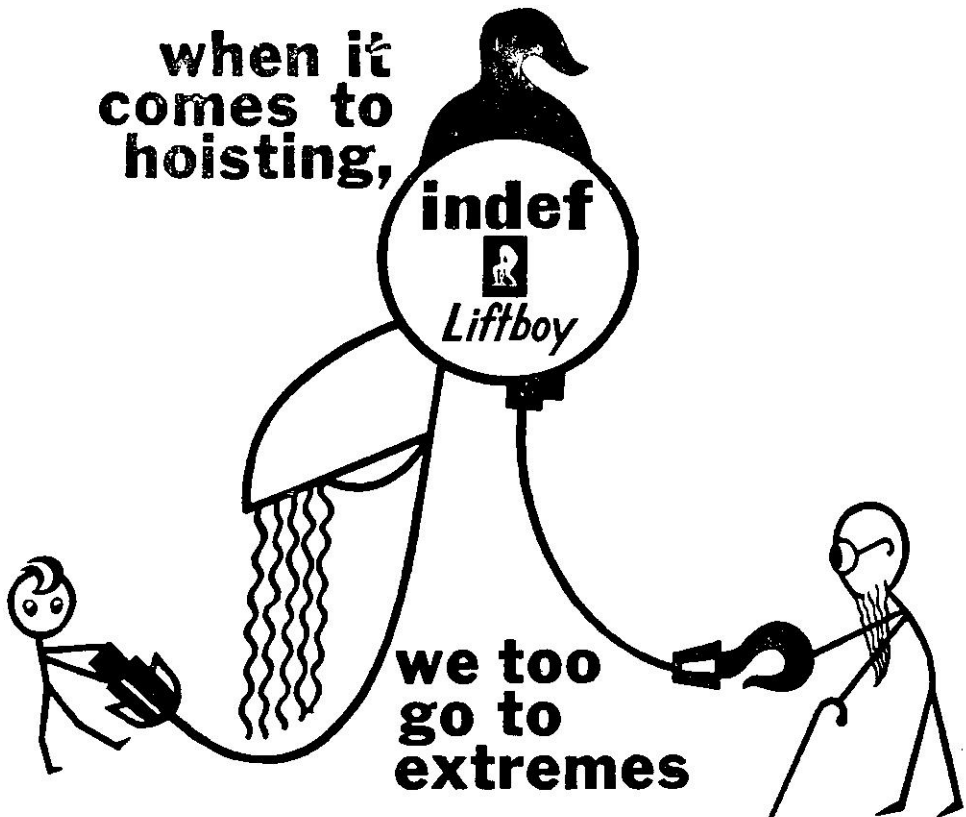
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Predetermined Motion Time Systems (incorporating MTM)	4	Jan 5	....
Job Evaluation & Merit Rating	3	Jan 5	Aug 17
Marketing Research	2	Jan 12	Nov 16
Human Relations	2	Jan 12	Jun 22
Production Planning & Control	6	Jan 27	Jul 6
Computer-Systems & Applications	2	Jan 27	....
Industrial Communication	2	Feb 2	Jul 27
Work Study	10	Feb 2	Aug 24
Cost Estimating & Pricing	3	Feb 9	Sep 14
Operations Research	3	Feb 16	Jun 22
Marketing of Industrial Products	4	Feb 23	Jul 6
Stores & Inventory Control	3	Mar 2	Jun 22
Training Methods & Techniques	2	Mar 9	Nov 16
Business & Industrial Management	4	Mar 16	Jun 29
Marketing Planning	2	Mar 30	Aug 3
Value Engineering	2	Apr 6	Sep 7
Office Organisation & Methods	4	Apr 6	Nov 16
Selection Methods & Procedures	2	Apr 13	....
PERT / CPM	2	Apr 20	Oct 19
Sales Budget & Forecasting	2	Apr 20	Sep 28
Materials Handling	3	....	Jul 13
Management Controls	2	....	Aug 10
Business Statistics	2	....	Aug 10
Production Management	4	....	Aug 17
Personnel Administration	4	....	Aug 24
Computer—Analysis & Design	8	....	Oct 5
Supervisory Development	2	....	Oct 12
Systematic Plant Maintenance	4	....	Oct 26
Field Sales Management	2	....	Dec 14

AT CALCUTTA — Residential

Course	Weeks	First Semester	Second Semester
Systematic Plant Maintenance	4	Mar 30	....
Production Planning & Control	2	....	Dec 14

AT MADRAS — Non-Residential

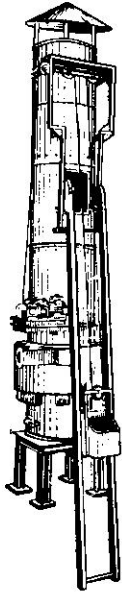| Course	Weeks	First Semester	Second Semester
Cost Reduction	2	Apr 20	Dec 14
Stores & Inventory Control	3	....	Dec 7

NATIONAL INSTITUTE FOR TRAINING IN INDUSTRIAL ENGINEERING
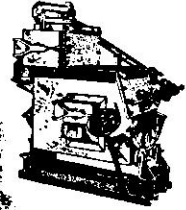A Government of India Project with U.N. assistance through I.LO.

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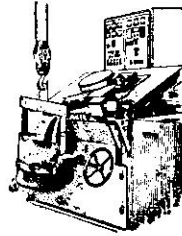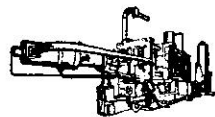
Industrial production gains momentum ... and Dunlop keeps the wheels turning

A measure of a country's development is its rate of industrial growth. The rise in industrial production during 1968 reflects the upward trend in India's economy.

Industrial growth has not only reduced dependence on imports but also helped increase national income. That's not all : industrial growth has also generated demand for a wide range of products—from giant earthmover tyres to tubes of adhesives.

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As industrial production gains further momentum—Dunlop India is equipped to keep the wheels turning.
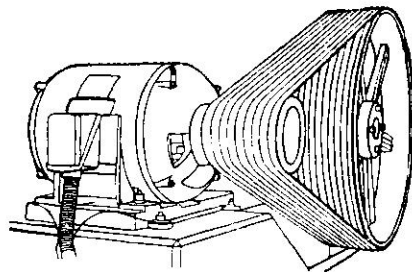
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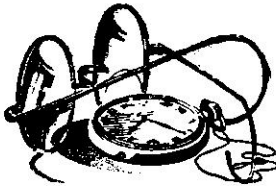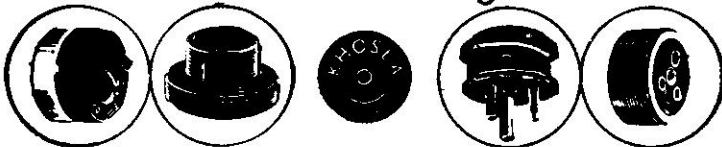
Foundry Comparison Ratios

YK Subramanya*

In the present highly competitive conditions in terms of quality, delivery, sale price, and with constant developments and improvements in manufacturing techniques, it has become imperative to work out scientifically developed ratios which reflect the production processes, with all their variables, to serve as a check on internal plant performance at different points of time, as well as for interplant comparison. These ratios are also useful in assessing the economic consequences of any new technical developments adopted. In this paper, the author has worked out the ratios for moulding sand preparation, melting and fettling processes of foundry.

IN MOST FOUNDRIES, THE TECHNOLOGY USED is developed by years of practice though it might lack the necessary scientific approach in some cases. To ensure efficient functioning, most foundries have established systems for statistical and cost information collection by which the performance of the unit can be compared over time. The information is also used as the basis for budgetting, target fixation, development programmes etc. However the internal comparison of performance do not provide a basis for interfirm comparison. This aspect of the matter is examined in the following paragraphs.

Inter-firm comparison schemes are mostly designed in financial terms like the percentage of profit on capital employed or the cost per unit output. Though useful to the investors and top managers, these do not furnish a satisfactory answer to underlying causes of va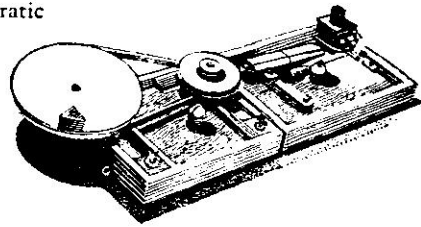riations in sectional outputs in different periods, or to the effects of new equipment or adoption of new technology on the production of the units concerned.

However, certain ratios have been made use of for a long time for comparison of performances. The ratios developed on the basis of present methods and technology, as for example output per unit area of the moulding section, are only applicable to local conditions and cannot be safely carried over to other foundries, particularly so in view of the varying degrees of mechanisation in different foundries. It is necessary to modify such ratios to suit the new

conditions.

The following points may be borne in mind in the formulation of the ratios:

(a) Considering the nature of production, detailed calculations should be made with a view to avoid subsequent discrepancies and bottlenecks in the individual production section.

(b) Lack of uniformity in mechanisation as between individual production sections leads to difficulties both in production as well as in measurement. Further, mechanisation should lead to a uniform loading over the broad range of functions.

(c) A sufficient and satisfactory check on the investment position should be kept at all times.

(d) Well formulated ratios on the technological processes should form the basis for comparison and serve as indices of the economic utility of the investment.

Taking these points into consideration, an attempt has been made here to work out the basis of the ratios applicable to the moulding, sand preparation, melting and fettling processes in a foundry.

Moulding Section

Making castings in sand moulds is the most popular method of production, with widely

* Foundry Manager, Cooper Engineering, Satara

different combinations of complexity in design, methods and special features of castings.

The different ratios for the moulding section are discussed below:

(a) *Average weight of casting per mould box* (*kg*): For a particular size of the mould box, the weight of the casting varies to a very wide extent depending upon the nature of the casting, wall thickness and the number of castings in the mould box. This ratio can be improved by suitable arrangement of as many castings as possible in the mould box in consideration. An increase in this ratio enhances the production rate to a considerable extent. This ratio is useful for internal comparison of performance so long as the nature of the castings made or the equipment available remains unchanged to a large extent.

(b) *Output per unit area* (*tonnes/m²*): This ratio can vary considerably from unit to unit, depending upon mechanisation, the nature of castings made, methods used and the weight of castings produced. The entire moulding area, including the area occupied by moulding machines, moulds and mould boxes, storages at the moulding station etc. is taken into account.

However useful this ratio may be for general comparison, both internal as well as interplant, its use as an absolute ratio of comparison is limited due to differences in equipment, methods, technology, etc.

The different technological processes can be best represented to include the influence of the different variables by capacity calculations. For example in the case of a pair of moulding machines the production capacity is equivalent to average weight of casting/mould and standard production (No. of moulds). The production capacity in terms of number of moulds is calculated on the basis of

$$\frac{\text{Available production time}}{\text{Standard machine time per mould}}$$

The available production time is the total time minus time lost due to breakdowns, overhauling, maintenance etc.

As the production capacity is based on good castings only, an acceptance factor as a percentage has to be included to take care of rejections.

Thus for a particular pair of machines the two factors which decide the production capacity are the average weight of casting per mould and the standard machine time per mould. As already discussed the average weight of the casting per mould box depends upon the nature of the casting regarding its wall thicknesses and allowances and the loading on the mould box. The drawback of the low casting weight in the case of thin-walled castings can be balanced to some extent by better utilization of the box area.

(c) *Specific output per unit area* (*tonnes/m² kg*): This is calculated as follows:

Specific output per unit area (Tonnes/m² kg.)	=	Total production tonnes/year/moulding area (m²)X average casting weight per mould box (1 g.)

This ratio is useful in effective comparison of performances in case of castings of different types moulded in nearly the same size of mould boxes. The absolute total moulding area requirement is to be decided in consideration of the sizes of the moulding machines, nature of the casting, cooling conditions, grade of mechanisation, etc. For a particular box size and transport arrangement lay-out, the moulding area requirement for a pair of machines of one type is almost constant, as can be seen from the formula.

As the total production for a pair of machines depends upon the machine cycle time, the specific output per unit area increases as the machine cycle time decreases, due to higher mechanisation, etc. Higher mechaisation also means increased moulding area requirement for a pair of machines.

(d) *Output per machine unit* (*tonnes per Hr.*): For machine moulding, a unit consists of a pair of machines, for a sand slinger, one. This ratio depends upon the cycle time or the production capacity of the machine in terms of number of moulds per hour and the average weight of the casting per mould box. Internal comparison is effective for a particular set of machines and to a limited extent for interplant comparison due to differences in the connected equipment involved.

(e) *Specific output per machine unit (tonnes/hr. kg.)*: This ratio is calculated using the formula given below:

$$\text{Specific output per machine unit tonnes/hr.kg.} = \frac{\text{Production Rate (tonnes/hr.)}}{\text{Average weight of casting per mould box (kg.)}}$$

This ratio takes care of the variations in type of load on the machines regarding the nature of the casting, wall thickness, etc. and the loading of the mould box.

(f) *Output per moulder (tonnes/moulder)*: This ratio depends upon the nature of jobs handled regarding their complexity, piece weight, etc., methods used and the extent of mechanization and as such cannot be carried over for internal or interplant comparison in widely different conditions of jobs, methods and mechanisation.

(g) *Specific output per moulder (tonnes/moulder Kg.)*: The formula giving the specific output per moulder is shown below:

$$\text{Specific output per moulder tonnes/moulder. kg.} = \frac{\text{Total production (tonnes/year)}}{\text{No. of moulders} \times \text{Av. weight of casting per mould box (kg.)}}$$

This ratio for a particular foundry can be improved by better utilization of the workmen in the Section or by working with less number of workmen.

Sand Preparation Section

The Sand Preparation Section in the foundry forms an integral part of the Moulding Section. The Sand requirement depends upon the nature of the casting and can generally be expressed by the ratio:

$$\frac{\text{Sand requirements per mould box including the ramming and spillage sand (m}^3)}{\text{Average weight of the casting per mould box (tonnes)}}$$

This ratio is often expressed in terms of sand per tonne of casting produced and is found to vary from 6 to 8 depending upon the nature of the jobs handled. The ratio depends upon the utilization of the mould box volume and can be improved by loading the mould box, thus increasing the average weight of the casting per mould box and also by making use of the smallest suitable mould box for the casting. Use of oversize mould boxes increases the moulding sand requirement, and along with it increases the preparation cost, handling problems and, in case of dry sand moulding method being used, the mould drying cost.

Melting Section

Yield is the most important ratio for the Melting Section and is defined as:

$$\text{Yield } \% = \frac{\text{Good casting weight tonnes}}{\text{Metal charged}} \times 100\%$$

This ratio can be improved by the following techniques:

(a) Reduction of gates and risers (returns) for a particular weight of the casting per mould box. This can be done by use of exothermic compounds, proper gating and risering methods etc.

(b) Increasing the weight of the casting per mould box and thus reducing the returns.

Another important ratio for the melting unit is the

$$\text{Melting capacity per unit hearth area (tonnes/hr.m}^2) = \frac{\text{Melting capacity (tonnes/hr.)}}{\text{Hearth area M}^2}$$

This ratio gives a good basis for comparison of performance of different melting units used for a similar purpose.

Fettling Section

Similar to the Moulding Section the following ratios are applicable to the Fettling section. These ratios are more useful when calculated separately for small, medium and large castings:

(a) *Output per unit area (tonnes/m²)*:

$$\text{Output per Unit area (tonnes/m}^2) = \frac{\text{Output (tonnes)}}{\text{Fettling Shop area (m}^2)}$$

This is only a general ratio well suited for internal performances during different periods so long as the nature of the castings handled and the degree of mechanization do not vary appreciably. As this depends upon the grade of mechanization, it is not easily usable for inter-plant comparison.

(b) *Specific output per unit area* (*tonnes/ M², kg.*).

Specific Output per Unit area (tonnes/m².kg.)	=	Total Output (tonnes/year)
		Fettling area (m²) × Av. casting weight kg.

This ratio eliminates the influence of the small variations in the weights of the castings fettled within their group of light, medium or heavy castings.

(c) *Output per fettler* (*tonnes*): This is highly dependent upon the fettling facilities provided and the type of castings handled but serves for overall interplant comparison.

(d) *Specific output per fettler* (*tonnes/ fettler. kg.*): The formula for this ratio is

Specific output per Fettler (tonnes/ fettler. kg.)	=	Total output (tonnes/year)
		No. of fettlers × Av. weight of casting (kg.)

As this ratio takes care of the minor variations in the casting weight, it gives a good basis for internal and inter-plant comparison where the grade of mechanisation is not too different.

The purpose of this paper* is to indicate the main ratios for the different sections of the Foundry, which can be used for internal and inter-plant comparison of performances. The information in this paper may serve

(a) to help overcome the common practice of judging the performances purely on the tonnage output basis;

(b) to develop the ratios which reflect the performances as truly as possible so that an effective comparison with the international standards becomes feasible;

(c) to check the profitability of investment; and

(d) to assist in the projection of foundries.
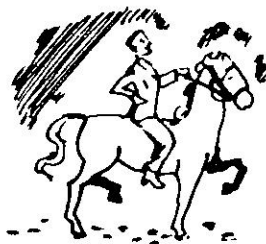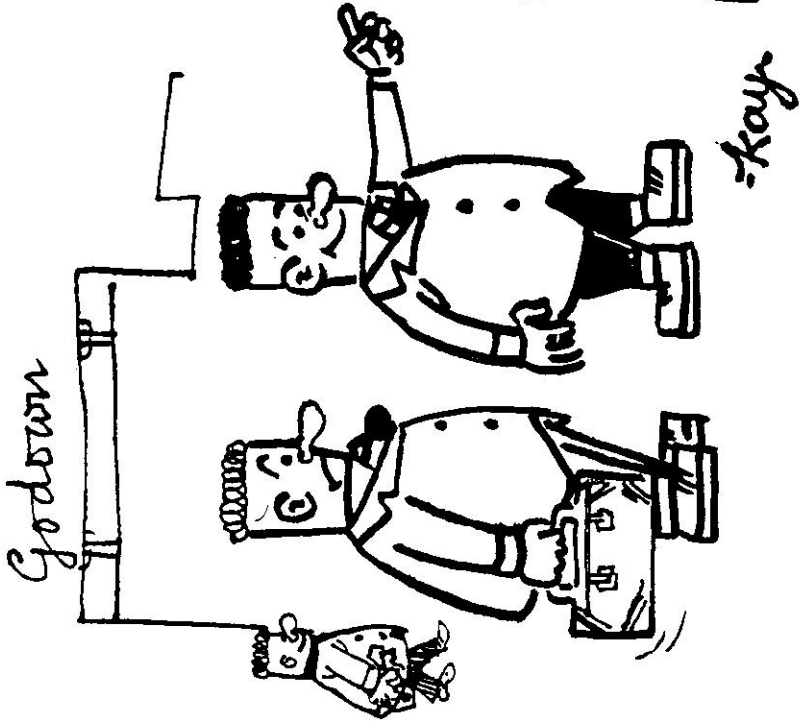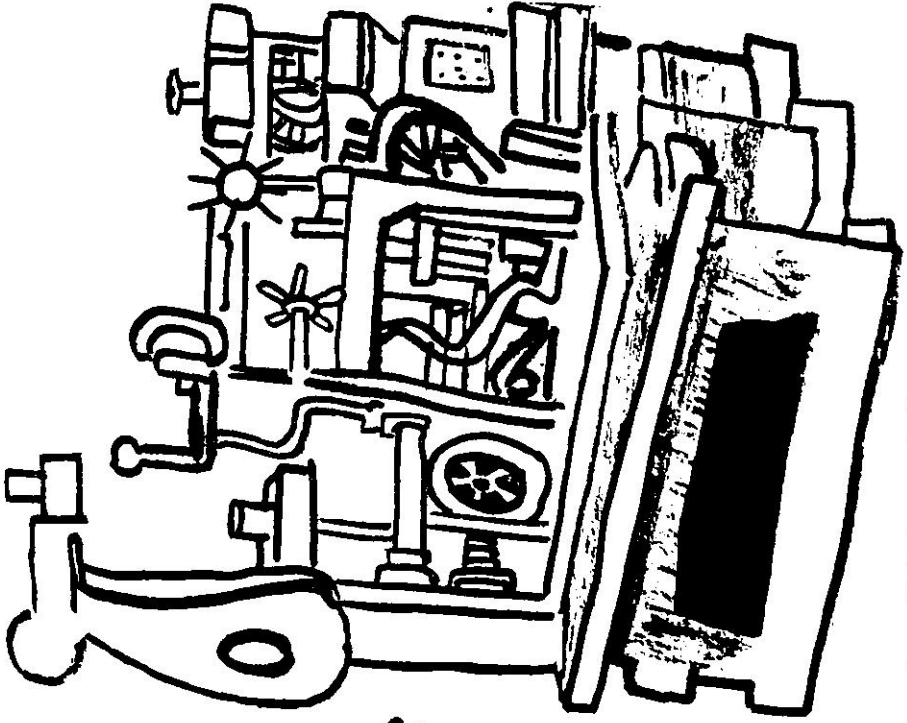
Of course ! It replaces four workers. But, to operate it eight persons are required.

The Markov Process

TR Chandra Sekhar*

The Markov Process has been very widely applied in Market Research, Advertising, Sales Forecast and other Management problems. Before giving an application of the process, a brief introduction to Markov Process is given.

THE MARKOV PROCESS CAN SIMPLY BE ILLUSTRATED by the example of customers buying Soaps out of two brands, A and B. A market survey is made and it is found that out of 600 customers who had purchased brand A on the preceding occasion, only 360 reverted to brand A, the remaining 240 changed over to brand B. Also out of 400 customers who had formerly purchased brand B, only 208 purchased brand B, the remaining 192 having changed over to brand A. This can best be expressed in a tabular form which when expressed as a fraction of the total of each row is called a **transition matrix.**

Present Purchase

		A	B	Total
Last Purchase	A	360	240	600
	B	192	208	400

TRANSITION MATRIX

	A	B
A	0.60	0.40
B	0.48	0.52

*Statistician, Oswal Mills, Kotah, Rajasthan

It is now required to find the market shares of each brand for any period into the future, under the assumption that the transition probabilities do not change much. The equilibrium solution is determined as follows:

Let a and b be the respective shares of brand A and brand B. Then

$$a + b = 1$$
$$a = 0.60\ a + 0.48\ b$$
$$b = 0.40\ a + 0.52\ b$$

By solving the above equations we get the solution

$$a = 0.48/0.88 = 54.5\,\%$$
$$b = 0.40/0.88 = 45.5\,\%.$$

In the long run, 54.5 % would be for brand A and 45.5% would be for brand B.

Application in Budgeting

In many industries in India the Management prepares a Budget for the coming year. For example, in a man-made fibre industry, while planning production the quality classification of the yarn is also taken into account: for there is a price difference and also it is not possible for the industry to produce 100% quality I yarn.

Usually the finished yarn is classified as I, II or N.S. (non-standard) quality.

The management would like to make a reasonable estimate of the percentages of the different qualities, on the basis of the past data available to them. Consider the following quality classification in the previous year.

	Quality		
	I	II	N.S.
Jan.	60	20	20
Feb.	75	15	10
Mar.	65	15	20
Apr.	55	30	15
May	70	15	15
June	80	12	8
July	75	20	5
Aug.	66	18	16
Sep.	72	20	8
Oct.	67	15	18
Nov.	77	10	13
Dec.	69	18	13

The above data can now be represented in the form of a Transition Matrix for January—February, February—March,....November—December, as given below.

	February				March		
		Quality				Quality	
	I	II	N.S.		I	II	N.S.
Jan. I	60	-	- -	Feb. I	65	—	10
II	5	15	. .	II	—	15	. .
N.S.	10	—	10	N.S.	—	-—	10

As shown above the transition matrix for March—April....April—May,....November—December can be prepared.

Then the corresponding figure in each cell of the matrix is lumped together and the final table will be as follows:

	Quality			
	I	II	N.S.	TOTAL
I	715	23	24	762
II	28	155	7	190
N.S.	28	10	110	148

When each cell is expressed as a fraction of the total of its row we get the transition matrix as follows:

	Quality		
	I	II	N.S.
I	0.938	0.031	0.031
II	0.147	0.816	0.037
N.S.	0.189	0.068	0.743

If a, b, c, be the respective per cent of I, II and N.S. in the equilibrium position, then

$$a+b+c=1$$
$$a=0.938\ a+0.147\ b+0.189\ c$$
$$b=0.031\ a+0.816\ b+0.068\ c$$
$$c=0.031\ a+0.037\ b+0.743\ c$$

Solving the above equations we get

$$a = 0.735\ \text{i.e. } 73.5\%$$
$$b = 0.156\ \text{i.e. } 15.6\%$$
$$c = 0.109\ \text{i.e. } 10.9\%$$

So the above percentage* of I, II and N.S. can be taken for budgeting purposes.●●●

*The above results can also be obtained, taking the power of the transition matrix: if the above matrix is called **P**, the matrix P^n for large values of n tends to the above solution.

Efficient Utilisation of Coal
for
Steam Raising

V Vihari*

In recent years, the technology of fuel utilisation has made tremendous progress. By adopting advanced techniques and using sophisticated equipment, it is now possible to achieve a thermal efficiency, as high as 88- 90%. However, the most fundamental and elementary principles of efficient fuel utilization remain the same. This article deals with the four fundamental factors of efficient fuel utilization. A few industrial trial results have been cited here, to prove the validity of the fundamental rules.

IN COAL COMBUSTION TECHNOLOGY, TECHNOLOGISTS often refer to the three Ts: **Time, Turbulance** and **Temperature.**

In addition, four other factors are relevant: (a) Size of Coal (b) Moisture content (c) Excess air (d) Fuel bed thickness.

If we pay the required attention to these four points, we may expect about 10-15% increase in thermal efficiency.

Size of Coal

The process of combustion requires an intimate mixing of oxygen with the coal. The larger the surface area of coal, the better the combustion process, enabling the combining of oxygen from air with the carbon of the coal. However, there would be limits, determined by fire bar thickness: the coal may pass through the bars without getting burnt.

Sometimes this loss known as combustible loss is of the order of 40-45%. This can be eliminated to give 5-6% combustibles in the ash, by adding the required amount of water to coal

*Consultant, NPC Regional Directorate, Calcutta

FIG-1
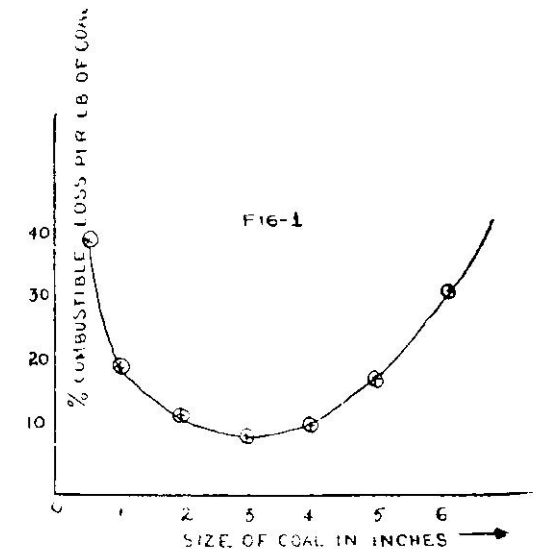
and also by selecting a suitable size of coal depending upon the type of firing used and the plant specification.

Moisture Content

A certain amount of moisture is essential so that the fines can stick to the lumpy coal. This

facilitates combustion and most of the fines can burn in the furnace. Usually when the coal supply contains about 20-30% fines, about 10-12% extra moisture in coal is found to be quite sufficient. It is an economical practice to wet the coal overnight and use it next morning. For this purpose, there may be soaking pits for coal in order to do the wetting in the proper way.

FIG-2
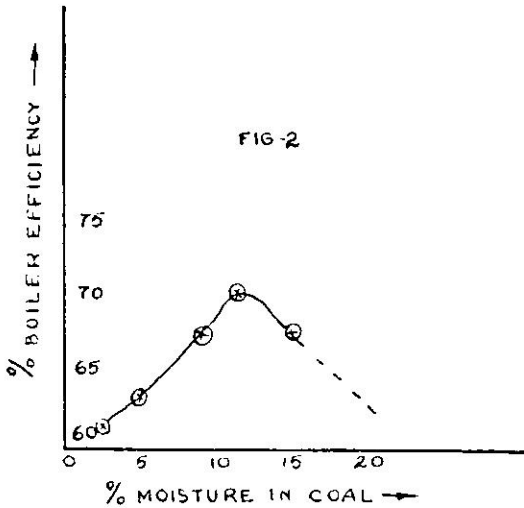
Excess Air

In practice, the theoretical air is not sufficient to burn the coal perfectly. Some extra air is required—the excess air. Experience shows that usually about 25-30% excess air is quite favourable for coal burning. If this excess air is reduced or increased, combustion is hampered; Firstly because, when the air supply is inadequate there will be excess formation of CO_2; the greater the formation of CO_2, greater the loss of carbon, i.e. potential energy. If too much excess air is supplied, it results in loss of sensible heat, as extra heat will be required to heat up the flue gas; and hence heat is lost. To have a compromise between these factors, an optimum value has been arrived at viz., 12.0% of CO_2. If this percentage of CO_2 in the flue gas is maintained, optimum combustion would be

FIG-3
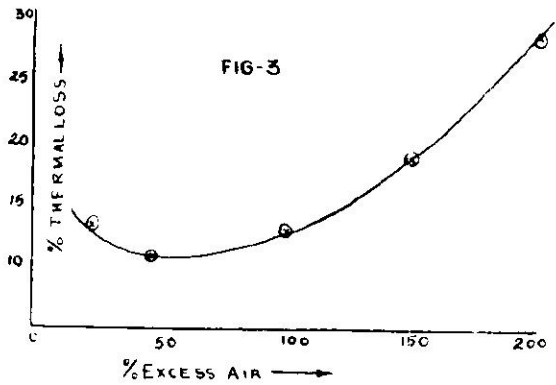
obtained. Draught, therefore, needs to be controlled.

Fuel Bed Thickness

Fuel bed thickness has also its own optimum value. If it is too high, the entire amount of coal cannot burn thoroughly, with greater possibility of CO formation, inadequate mixing of oxygen resulting in incomplete combustion, and loss of fuel in the form of combustibles in the ash. If the thickness is very much less, then the optimum combustion will be very fast; also a part of the coal may pass through the chimney in the form of fly ash, etc. By experience it has been found that about 5.0″ fuel bed thickness gives very good results.

FIG-4
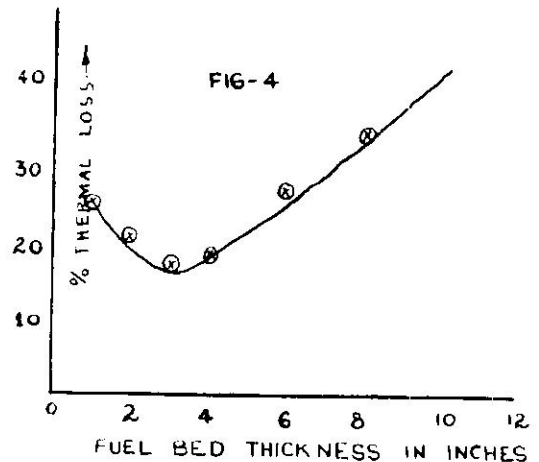
Practical Experience

In several industries we have experienced that if the above factors of efficient fuel utilisa- tion are attended to seriously, a fuel saving of the order of about 10-15% is obtained, as illustrated in the following examples.

BOILER TRIAL RESULTS

Industry: **Vegetable Oils**

Trial No.	Avg. Pressure in PSIG	Qty of Steam Generation in lbs	Coal Consump-tion in lbs	Boiler Efficiency %	Remarks
1.	230	60,900	10,527	55.21	Normal Condition
2.	230	53,875	8,239	63.57	Improved Method

$$\% \text{ Saving by improved firing} = \frac{(63.57 - 55.21)}{55.21} = 15.1\%$$

Cotton Textiles

Lancashire Boilers

Sl. No.	Avg. Boiler Pressure in PSIG	Boiler effici-ciency %	Remarks
1.	95	43.8	Normal
2.	95	44.0	,,
3.	89	52.5	Improved
4.	80	47.2	,,

Avg. Eff. Normal condition = 43.9%

Avg. Eff. Improved condition = 48.85%

$$\% \text{Saving by Improved firing} = \frac{(48.85 - 43.9) \times 100}{43.9}$$

$$= 11.35$$

Jute Mill

Sl. No.	Avg. Pressure in PSIG	Boiler effci-ency %	Remarks
1.	80	38.7	Normal
2.	80	44.7	Improved

% Saving by improved firing

$$= \frac{44.7 - 38.7}{38.7} = 15.5\%$$

Conclusion

The trial results of boilers installed in various types of industries show a fuel saving of about 10-15% as easily achievable, through improved practices, as compared to the results obtained through the usual firing techniques.* ●●●

*The author is thankful to the National Productivity Council of India for permitting him to use the boiler trial data pertaining to various industries in connection with the fuel and steam utilisation survey and also to publish this paper.

Productivity
and
Economic Growth

A Case For An Underdeveloped Economy

DB Gupta*

As an almost inevitable consequence of full employment of resources in the advanced countries, the post-war era has witnessed quite an unprecedented interest in productivity studies. With the resources fully employed, productivity has taken the centre place of discussion, because the problem of economic growth of these countries has become one of increasing the output from the available resources through increasing resource efficiency, i.e. increase in productivity. †

IF THE SUPPLY OF LABOUR AND CAPITAL IS given and is fully employed, and if C denotes the real capital and K its average productivity (i.e. C/Y where Y is the national out put), then we have the relation

$$Y = C \times K$$

Differentiating with respect to time t, we have $dy/dt = K$. $dc/dt = C$. $dk/dt \ldots$ (i) this relation (i) shows the theoretical possibility of output growing as a result of increasing real capital (dc/dt) or through increase in productivity of capital (dk/dt) or both. But by assumption dc/dt is zero as the resources are fully employed; there being no scope of increase in them in the short-run, the only possible way to have economic growth (dy/dt) is through increase in productivity of capital (dk/dt).[1]

One of the consequences of such a shift of emphasis, has been an increasing volume of empirical materials concerning productivity in recent years. These empirical studies have thrown much clear light on the growth experiences of the advanced countries. For example, the statistical study carried out by Mr. J.M. Kendrick[2] points out that for the period 1899-1953 the total factor productivity in the USA increased at a rate 1.7% per year which is more than half of 3.3% the rate of growth of real output per year, while only less than half the increase in output was due to increase in quantities of inputs. This shows that qualitative changes in the use of inputs are much more important than the quantitative increase in inputs in generating economic growth.

In view of the fact that technological changes are generally embodied in the use of capital and labour, it is difficult, if not impossible, to segregate the contribution to the process of growth, by rising factor efficiency made

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* Lecturer in Economics, Sardar Vallabhai Regional College of Engineering & Technology, Surat.

† In fact in order to contain inflation inevitable under full employment conditions, Productivity has become the principal guideline in Incomes Policy as determining the upper limit to which rises in incomes may be permitted.—Editor

1. K. K. Kuriara: The Keynesian Theory of Economic Development (George Allen & Unwin Ltd., London, 1959).

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2. JW Kendrick: Productivity Trends in United States (National Bureau of Economic Research, 1961, P. 251.)

possible through technological progress.[3] However, the studies are suggestive of a significant contribution, which can be made by the rise in factor productivity, to the process of growth. In fact, as J.W. Kendrick points out "the more we can learn of economic growth generally, and of productivity changes in particular, the better equipped we are to survive the competition and to enjoy continued advantages in our planes of living."

If this is the importance of productivity rise in the process of economic growth of the developed countries, the questions that immediately arise are: what is its importance in the development of underdeveloped countries? Is there any scope of increasing productivity of such countries? If yes, then, how can the factor productivities be increased in these countries? These questions are sought to be answered in the following paragraphs; and there is at the end, a concluding portion, relating to India.

Underdeveloped Countries

Obviously, the need to increase the factor productivities is present in both types of economy, developed as well as underdeveloped. The need for productivity increase, however, stands on a different footing in the two types of economy. In the developed countries, as already said, the near-full employment of the factors of production dictates a raising of factor productivities in order to enhance growth, while in the underdeveloped countries the need to increase productivity arises essentially beacause of an all-round scarcity of capital equipment and entrepreneurial abilities, raw materials and wage goods. Under such scarcity conditions, the need to raise productivity is even greater and more urgent than in the developed economies.

3. The most important contributions in the field are: R. M. Solow: 'Technological Change and Aggregate Production Function', (The Review of Economics and Statistics, Vol. XXXIX, Aug. 1957).

S. Fabricant: 'Economic Progress & Economic Change'; 35th Annual Report, National Bureau of Econmic Research, 1954.

W. Leonther: Studies in the Structure of the American Economy (New York 53), E. D. Domer: On the Measurement of Technological Progress (Economic Journal Vol. LXXI Dec. 61).

4. J. W. Kendrick. op. ct. page 248.

As there is scarcity of all types of inputs[*] including that of wage-goods, in an underdeveloped economy, the growth process in such an economy, in its initial stages, can be easily stimulated if reliance is put on raising factor productivities. Thus all the available stock of scientific knowledge that can find commercial application has to be used for raising factor efficiencies. Governmental policies can be used to stimulate such increase in factor efficiency. Hence the raising of factor efficiency, whether in developed or in underdeveloped economies, needs special attention in both the economies; only the difference would be in respect of emphasis and not in the fundamental approach.

Really, the distinctive characteristic of an underdeveloped economy is its structural imbalance of the factor supplies, in the sense that it has a relatively abundant supply of crude labour in relation to the supplies of factors complementary to labour. This leads to a distinct approach to productivity to be followed, as opposed to the approach in a developed economy. In a developed economy, labour is relatively the most scarce factor, and as such the emphasis in such an economy has to be ultimately to economise the most in its use. Thus the general trend of emphasis of all innovations in the long-run, in a developed economy has to be to raise labour productivity. However, **this sort of emphasis on economising in the use of labour is neither desirable nor beneficial to an underdeveloped economy.** Hence, though an underdeveloped economy will also benefit from raising labour productivity, if it rose without any substitution of other relatively scarce factors for labour, but it is not in its interest to emphasise the productivity of labour relatively to the productivity of other factors.

No doubt, a rise in factor productivities is always beneficial, but the rise in the productivities of the more scarce factors like entrepreneurial abilities, managerial talents, skilled technicians and capital equipment, is much more beneficial as compared to a rise in labour productivity.

* **Not of Labour!—Editor**

The Scope of Increase in Productivity[5]

There is recent evidence of a wide variation in productivity in similar jobs as (i) between averages in different countries; (ii) between averages of groups of workers under different managements in the same country; and (iii) between different workers under the same management. All these differences in productivity between countries, between factories and between individuals in similar jobs give definite hope that most levels of productivity can be improved upon.

The causes and conditions for the variations are, of course, many and have repeatedly been systematically presented in various models by different authors. They can be divided broadly, into conditions acting through the 'human factor' that is, the workers' capacity and willingness to work, and those that 'by-pass' the human factor altogether, such as speed-up machines, new types of equipments, environment, material and non-material.

Many of the great discrepancies in productivity between countries are the result of different degrees of mechanization; and as such these discrepancies could be minimised through systematic imitative innovations. But the discrepancies between factories in the same country and especially between the workers within the same factory, are usually the result of different conditions affecting the human factor. It is possible to increase productivity by means of economic incentives, and such measures are commercially feasible. It is, for instance, possible that "the continued presence of young research associates observing them will increase the output of a group of girl operators as happened in the Elton Mayo experiment; but this method is expensive in salaries and fees and is not likely to be adopted as a permanent feature of any factory policy."[6] It is, therefore, essential that the incentive policies must be economical to the management concerned.

Approach to Increase in Productivity in Underdeveloped Economy

The most vital problem that any underdeveloped economy would face is: How can the factor productivities be increased? In any economic system, factor productivities can be increased in two fundamental ways:

In the first place, within the given state of technical knowledge, factor productivities can be increased by avoiding waste of all kinds in the system, since productivity in a way "stands for elimination of waste in all forms".[7] It should be noted here that there is tremendous scope of increasing productivity of labour without severe unemployment by elimination of different kinds of human waste, which are generally not readily discernable. For example, "if the very objectives pursued by an organisation are wrong or against its own interest, then, however diligently and efficiently the staff may be applying themselves to their work, the contribution to productivity, in the final analysis, will be naught....Wrong choice of a profession for which the person has no aptitude and to which he is not suited can mean a whole life-time wasted. Similarly, wrong placement can result in a career-long ineffectiveness. And, most important, the waste of human morale through frustration, dissatisfaction and disillusionment."[8]

Thus planning at micro and macro-levels should first concentrate on measures to avoid waste. In our context the avoidance of waste of entrepreneurial and managerial abilities, and that of resources like materials, equipments, space and buildings, is far more important than that of other factors of production. An underdeveloped economy will have to devise fiscal, monetary and other economic policies that would help to minimise the waste of the highly scarce factors.[9]

5. Detailed discussion will be found in J. P. Davison & others: Productivity and Economic Incentives (George, Allen and Unwin Ltd. London, 1958).

6. J. P. Davison op. ct. p. 16.

7. K. Pennathur: Productivity is For You Too (National Productivity Council, India, 1966) p. 4.

8. K. Pennathur: op. ct. p. 5

9. It should be noted here that the current industrial and labour policies are likely to lead to substitution of capital for labour, which is not desirable for an underdeveloped economy like India where labour is relatively abundant. It will be of great interest to study the impact of our current industrial and labour policies on factor substitution. It was pointed out as far back as 1956 by K. Mukerji. "......It is a policy with some of the industrialists to substitute labour by capital, irrespective of direct economic cost as an insurance against labour troubles which is ensured on two counts, viz., keeping down the number of labourers to a

However, the gains in productivity which can arise by avoiding waste, though substantial in the early stages, are of the nature of once-for-all benefit. Forgetting a continuous rise in productivity, the only way is to continue to embody innovations within the system. For successful embodiment of innovational changes in the system, what is required is entrepreneurial abilities and technical know-how and the availability of necessary capital. The former is relatively very scarce in underdeveloped economies and can be augmented by creating a healthy climate for entrepreneurial and research activities. The latter can be augmented by increasing the rate of savings which is possible in the initial stages only through curtailing the growth of nonessential commodities.

With the aid of fiscal and economic policies by the Government, a progressive attitude on the side of both workers as well as owners of industry, and above all the earnest efforts of engineers and technologists, the technological gap between the developed and underdeveloped countries can definitely be narrowed down.

Application to India

To summarise what we have said so far, it should be said that in order to bridge the gap in the standard of living between the developed and underdeveloped countries, underdeveloped countries must increase the ratio of output/population at an accelerated rate. In an underdeveloped economy like India, where population is increasing, the problem of increasing output at an accelerated rate becomes more pressing and more ticklish. It has to be attacked from all fronts. In such a condition, the country should not only increase the rate of its capital formation at an accelerated rate (in order to increase the ratio of capital/labour i.e. C/N) but it must also eliminate waste of all forms and develop technologically anyhow (in order to increase its factor productivities, Y/C and Y/N).

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minimum and raising the productivity and hence the wages of the employed labourers to give differential advantage over the other employment and thus tying them to the existing employment." (K. Mukerji: Employment Substitution of Capital for Labour, *The Indian Economic Journal*, April 1956, p. 417)

However, for a capital-scarce country like India, the only way to accelerate economic development is through technological progress in terms of factor productivities. Thanks to the developed countries, we have not to search for new techniques, at the present stage, but to learn and to adopt the known techniques for increasing factor productivities of our scarce resources. Hence the only way before us is to imitate, to innovate and to improve, if possible (to suit the local conditions), these known techniques in the shortest possible time.

Due to scarcity of capital, it is sometimes held that underdeveloped countries should start with simple improvements in their own technology and postpone the adoption of the modern capital-intensive technology to a later stage when their output has been first enlarged. This is sometimes called the strategy of 'deferred rapid growth' in contrast to that of the 'immediate rapid growth' that is inherent in the process of bridging the technological gap through innovational imitation immediately. Obviously, there is some type of technological progress that does not require any capital expenditure in any industry. For example, there is tremendous scope for growth through better industrial and agricultural organisation. With the proper planning and control techniques, it is usually possible to squeeze a greater output and often a very much greater output from the existing equipment; because the lack of efficient planning and control is one of the outstanding features of Indian Industry and agriculture, attention to them could bring greater growth from existing plants and equipment.

It is sometimes held that the process of development should begin with the main economic activity of the concerned economy. There is no denying the fact that agriculture is still the main activity of India and there is tremendous scope of increasing agricultural productivity in India through increased irrigation facilities, better manures and fertilizers, improved equipment and farm practices and better seeds. However, it is not merely the increase in farm inputs that would bring the desired result but the inputs that go into the farm must be effectively utilised. Hence an improvement in farm organisation, in rural credit, in agricultural

marketing, in land system and rural extension work will go a long way in raising agricultural productivity in India.

This clearly suggests that there is an imperative need for a productivity approach in Indian agriculture. Productivity is the motive force underlying rationalisation of the various inputs that go into agricultural production. It is, therefore, argued that in addition to the traditional inputs in agriculture, if we also make use of productivity techniques in Indian agriculture, there will be significant improvement in agricultural production in particular and economic growth in general.●●●

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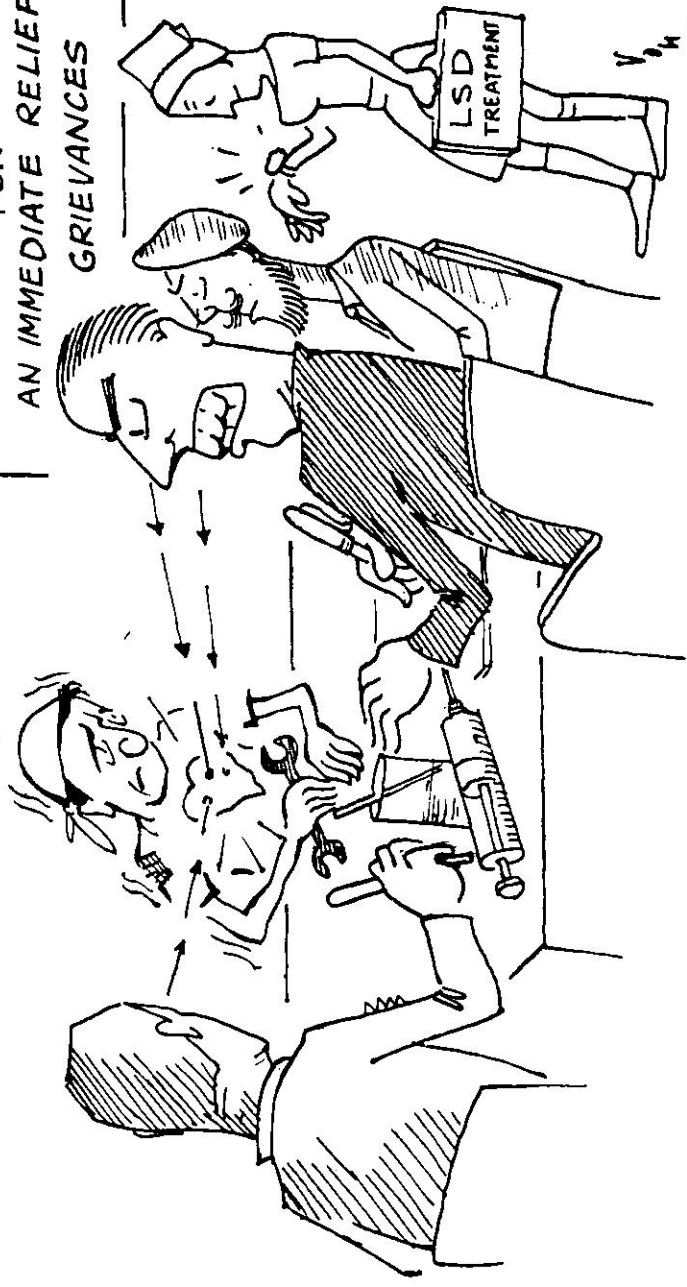
Productivity
in
Research & Development

SC Aggarwal*

Due to the inter-disciplinary nature of the functioning of industrial laboratories and institutions, it has become rather difficult to define work areas in a very precise way. The scientists and engineers are expected to know the elements of economics and finance; whereas purchase, stores and finance executives can be more helpful if they understand engineering and manufacturing functions. It has become a rather mixed business. In this article the author has attempted a clarificatory analysis, in order to pinpoint areas for maximising the productivity of resources invested in Research and Development.

FOR LABORATORIES AND SCIENTIFIC INSTITUTIONS it has now become essential to divide their scientific and technical work into four major work areas: (i) Research (ii) Development of Plans and Programmes (by making use of Analytical Aids, Systems Analysis and Operations Research Techniques, etc.), (iii) Design and Development of products for large-scale production, and (iv) Supporting activities of a non-scientific, non-technical nature.

The experience of successful research organisations in advanced countries as well as in India leads us to believe that it is advantageous to place Research, Programme Development, and Development Operations under three different heads, with responsibility and corresponding authority precisely defined. Preferably, there should be a separate officer, responsible for the management of non-technical operations assigned to the supporting staff. These four officers can work as a Committee for integrating the operations and for developing the commonness of purpose and action essential for the success of highly professionalised work of a creative character.

*Professor of Industrial Management, Indian Institute of Management, Ahmedabad.

Segregation of Research Work

All research work needs to be segregated completely under a single head. Many cases can be quoted where such a step was found to be essential and fruitful for obtaining the desired level of performance in research. For example, Jyoti, A.C.C., Hindustan Levers, Voltas have placed all their research and development work under special research committees. Segregation increases the vitality of the Department/Section and creates an atmosphere conducive to best performance. Further, this type of arrangement promotes a healthy and creative relationship of the research staff of the concern with the general scientific community. This serves two purposes: the concern gets from outside a flow of knowledge, profitable to its operations. Its own scientific work becomes known so that promising young scientists are attracted to work in the concern.

In the past, laboratories, to the extent they existed, occupied a ramshackle position in the backyards of factories, making use of common equipments and facilities, down to the design and development stage. Obviously, such arrangements could not be satisfactory from the point of view of Research, and often it was a disincentive to high quality research workers.

However, by now the battle for a separate Research Division has been for the most part won; yet the resources for R and D remain scarce in relation to the needs of development; hence it needs considerable thought as to how to distribute the available amount amongst the many specialised areas of research; and someone at the top has to exercise his judgment, how to maintain a balance in the rate of acquisition of new knowledge between different areas. The head of the company, the head of the research division, together with the heads of specialised sections, should individually and collectively try to estimate the future growth and profit potential of unexplored areas of science, relevant to their industry.

In this context, it appears worthwhile to emphasise the criticality of the time-gap between the acquisition of knowledge (created in laboratory or acquired from somewhere else) and the use of that knowledge for new products through design and development. Research in Industry is intended to minimise this time-gap. The researchers keep on independently producing new scientific knowledge, developing techniques and arts which combine to make a reservoir of new information, etc. etc. The scientists working for industry have to make all this new knowledge and new information available to industry in a readily usable form; and time is of the essence. And for achieving optimum results, the members of the research department must exchange information with the development staff. The development men in turn must learn new tools and techniques for accomplishing new tasks created by the new advances in research.

Programme Development

The functioning of the Programme Development Department, including the utilisation of new knowledge and making it usable for the particular line of industry involves, in the first instance, a detailed analysis of the new developments, a close look at the new knowledge and techniques; and the systems analyst must evaluate it all before a programme is drafted.

Obviously, such programme drafting can only be done on inter-disciplinary basis; and we may as well use the proven operations research techniques, establishing the performance characteristics of newly proposed systems, its sub-assemblies etc. The Report may as well include an estimate of cost structure for the new system when fully developed and fabricated in commercial quantities, including the service and economic value aspects of the product. The Company must know the technical characteristics of the new products and systems, and enough evidence must be marshalled in favour of the proposed system, to be realised through internal design and development facilities, without any necessity of further research.

Research authorities must accept the full responsibility for the details of their research programmes, but this does not entitle them to take final decisions regarding the development of new systems. As said before, this can only be done satisfactorily on an inter-disciplinary basis, but if any one can claim the final say, it must be the Plant Personnel, who have to work the New System. In any case, at some point, somebody has to judge the value of new research and authorise Design and Development to go ahead with it; and priorities must be established; for the number of new products/systems is much larger than the capacity of the Design and Development Department. Here too, somebody at the top must take a decision.

After a decision has been taken, the development authorised under the priority sequence becomes the responsibility of the Design and Development Department. The department prepares a report, outlining the general technical plan for each project. The question arises, when, for some good reasons, certain changes in the main framework of research become essential: they have necessarily to be referred back to the Programme Development Department; and only this department should have the authority to approve such changes. However, the department is expected to keep in close touch with all the ongoing designs, field-trials, proto-type manufacture, test marketing etc, and it must coordinate all the needed revisions, modifications etc. It must maintain close contact with researchers, designers, engineers: this would help

in making the new product or system the result of the combined judgment of the experts of all the Company's departments. The Birla Research Centre at Nagda, the Jyoti at Baroda, and several other Research centres are working on some such lines. Systems are after all an aggregate of components or elements; there can be thousands of them in one system. The Programme Development Department need not concern itself with the components. It is concerned with the aggregate as a whole. It should only determine whether there is already in existence enough knowledge and art necessary for the design and development of the needed components for the system under consideration, and its priority in the total system. However, specifying the details of the components and assigning the tasks of new component development to the appropriate sections should be done by Design and Development department.

A Programme Development Department might sound a new concept, but in advanced countries it has been practised for nearly 20 years. Most of the Companies like Bell Telephone, General Motors, Ford Motors, General Electric Co., etc. having their own Research and Development departments, have well-developed Plans and Programmes Development techniques, and a separate department for their application and use. Most of these techniques have already been proved to be valuable tools in the hands of management. It is now rare that the laboratory needs to go through two or more parallel developments for making a choice. Choices are made in the course of programming studies. The Plans and Programmes Development Department makes available to the manufacturing plant a detailed report on the possibilities of new developments, their service, economic growth, etc.

The Plans and Programmes Development Department considers all the aspects of design, development, manufacturing, etc. much in advance of development being actually undertaken. Of course, the number of scientists in the Plans and Programmes Development Department is usually very small: not more than 10 to 15 per cent of the size of the Design and Development Department. However, the experts in the Department of Plans and Programmes should be scientists and engineers with some specialized training in Operations Research techniques, not necessarily mathematicians, who may as well create more confusion than systematization. Thus, before any design and development work is taken up, Plans and Programmes Development work must be done in detail, and analytical reports prepared and reviewed in consultation with the manufacturing personnel.

It may be necessary to add here that while an appropriate organisational set-up and work-system are very important, the most important factor is the quality of the professional people. Some people nowadays go so far as to say that even mediocres can achieve great success in a good organisation with an efficient work system. However, it may be said categorically that in Research, mediocrity is suicidal, self-defeating, to say the least. In this sphere, the difference between a brilliant scientist/engineer and an average one is almost astronomical in terms of the quality of results: progressive companies therefore bend all their energies to maximise the percentage of high grade scientists amongst its professional people. In advanced countries, only doctoral level personnel are employed in research work; and quite a few men with post-doctoral academic experience are added each year. The recruitment of professional and research staff is almost autonomously controlled by the research staff.

Since, however, the available supply of doctoral level people is limited, it becomes necessary to employ some technical graduates, particularly for Design and Development work. Even here the recruitment of these graduates has to be restricted to the top 30% of the class, because only the top boys can successfully tackle the problems of development. This would serve a double purpose, for even technical graduates, after long training in a laboratory, can be brought up to the doctorate level. Several R & D establishments in the U.S.A. report that such training helps greatly in increasing the Productivity of Research. This training period also serves as a screening tool for the new entrants.

Non-Professional Assistance

The foregoing argument must not, however, exclude the employment of non-professional assistants, who may be found to be particuarly useful in speeding up experimental work which otherwise may be held up for want of scientists or engineers. Nevertheless we must guard against the possibility of the scientist or the professional man losing contact with the experiment itself, and the source of his inspiration and new ideas; hence the quantum of non-professional aid must be kept within limits. In research organisations the actual strength of non-professional staff to scientific staff varies from 1:1 to 4:1. Sometimes, non-professional staff is trained in night engineering colleges, but it has not been possible to promote them to professional status, as the experience of many companies with such promotions has not been very happy.

However, this should not preclude non-collegiates being trained within the company to enhance their skills as aides, but not as professionals. After training, these men can achieve a fair level of competence. Progressive research organisations can provide such men fairly satisfactory careers and salary ranges and may even offer the attraction of rising high, if they could make the professional grade. Such non-collegiate aides prove themselves most suitable for the positions of technical assistants to professional/scientific men and help them in achieving their maximum productivity.

In dealing with salary scales, it may be said here that good laboratories and organisations keep themselves informed about the salaries and patterns of compensation in progressive industrial laboratories and keep their own pattern well into the higher levels of payment. Jyoti, A.C.C., Voltas, Levers, Ciba and several other companies are offering a little higher range of salaries to their research scientists compared to what equal status employees of other departments get. To attract the best personnel from the open market, the policies and criteria of compensation must be declared well in advance and should be communicated both inside and outside the organisation; and they should be kept under review from year to year, and adjusted according to availability and needs of development.

Communication Vital

Effective internal communication is most desirable. Progressive research organisations issue booklets to their fresh personnel, immediately on induction. These define basic philosophy, the mechanism of salary administration of the research organisations or laboratories. Any professional or non-professional, whosoever desires, is allowed to discuss his position in regard to his salary and the reasons therefor, with his supervisor. It is generally agreed that the more interest the top man and the senior officers take in giving straightforward and satisfactory answers to their employees, the higher is their productivity. Experience indicates that good communication is of the utmost importance and even the best possible treatment may leave dissatisfaction.

Good attention must therefore be paid to building up and oiling the channels of communication. This is particularly important, where professional people are involved. Sensitive as they are, they want to know (i) the management policies, (ii) the action it takes, (iii) the why of organisational changes, and (iv) details of outstanding scientific, and technical matters under consideration of management. For keeping professional people satisfied, it is good if they are kept informed about these things through some sort of an official bulletin which must give clear and timely information relating to policy and professional matters.

And it is also essential to know the views, attitudes, problems of professional personnel, if possible through expert psychological studies. However, anonymity in these interviews must be ensured and scrupulously maintained. This sort of communication up the line can become a very important source of information and help the management greatly in providing an environment, conducive to high morale.

It has been said that the quality of the professional people is the single most important

factor in the productivity of R & D, but that alone will not achieve a high level: professional men must also be provided with the right climate within the organisation, if creative effort is to be successful. It is more so in the case of research and development because intimate group work is involved, and the minimum level of achievement, considered desirable, is fairly high.

The creation of the right kind of climate presupposes, in relation to professional personnel, as essential to the job, the accompanying group spirit, material rewards, ego satisfaction etc. etc. These problems become all the more complex as the size of the organisation gets bigger and as the social pattern changes. The human problems in this field are different from and are additional to those of the planning, designing, development and manufacturing problems. Unfortunately, managements have paid too much attention to planning, designing, development and manufacturing problems. There is little awareness of the vast amount of knowledge that comes out from universities where the climate and environment have been helpful to professional men engaged in research and development work. To some extent, some of the industrial laboratories of large companies are attempting to duplicate the university type of climate and environment for their research departments. What some companies, like the Jyoti of Baroda, have done is to retain university professors as regular visiting consultants, allowed to mix freely with their own full-time researchers.

Something has to be said for this, for the university atmosphere does not put any stress on organisational structure; rather it encourages an atmosphere of informality, unhampered by standard working hours, liberty to study and contemplate at home, freedom to publish anywhere, encouragement to attend scientific seminars and conferences, etc. Industrial laboratories have the additional advantage of large resources available to them. They can become important supplements to the universities and in a developing economy like ours, industry has got an obligation to make such a contribution, more so when Indian tax laws allow amortization of expenditure on Research and Development upto 40% per annum. Of course, the economic gains in themselves will be substantial.

In all this discussion, one should not forget adequate and functionally oriented buildings for scientific research and other ancillary facilities. Research studies conducted in the USA underline the profitability of this line of approach. The design should provide flexibility in changing room sizes just by making use of movable partitions. Laboratory services, such as water, gas, vacuum, power lines, etc. must be so distributed that they do not get disturbed while changing the room sizes. Furniture and technical facilities should be such that they can be easily moved from place to place.

Day by day the instrumentation for research and development is getting increasingly complex. The ease and economics of purchasing instrumentation from suppliers have greatly increased the efficiency of R & D departments because a large amount of time and effort get saved, which otherwise would have been spent in the development of needed instrumentation.

Buildings and facilities need expense, and managements often resist such expenditure. That holds up the construction of new buildings and facilities, and because of that, efficiency suffers greatly. However, there are signs of change. Several of the progressive managements mentioned in this analysis have research departments, housed in their best buildings, and with excellent facilities. ● ● ●

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Don't Talk About Productivity

"... As for the need for harder work or greater productivity, it is by now bad form, if not downright reaction, even to talk about it..."

Sham Lal on the 'National Scene', *The Times of India*, 31 Dec. 1969

Labour Motivation in India

SC Bhattacharyya*

Most advanced nations have, over time, evolved a workable self-generating motivating force for the working class. In Japan, self-discipline and a sense of security amongst the workers have contributed not a little to Japan's unparalleled industrial progress. Workers in the USA, which is a highly materialistic society, produce more to earn more. Political doctrine in the USSR exerts a considerable influence on industrial society. In Germany and the UK, traditional nationalism and dignity of labour have been their greatest asset. *Money was never a dominant motivating force in any country*, except to a certain extent in the USA, where even the money-concept for motivation is fast changing. India cannot depend on any one of these motivating forces. In fact, spiritualism, religion, ethics and traditions still dominate the Indian society. *What then can be recognised and developed as the motivating force in India?*

A LARGE PART OF INDIAN INDUSTRY HAS NOT grown within a framework of scientific management. Business has been a hereditary affair and business traditions have changed little. After Independence, many traders have become industrialists. In the public sector, large undertakings have been managed by administrators who had not grown with industry. Of necessity, there have been many foreign collaborations in which the managerial system remained typical of the respective collaborating country. With such heterogeneous management practices prevalent in Indian industries, no definite pattern or industrial philosophy has emerged. In fact, there has not been a conscious effort to do so, although **the social systems and sentiments of the Indian people can make management philosophy a most viable motivating force in India.**

Philosophy and Conscious Direction of Management

Management philosophy should not be a reflection of the executive's or owner's psychological complex or social and intellectual background. An owner or an executive should realise that a worker is a different man in his place of work than what he is at his home or outside the Company. In his home, he may not have water supply, lavatory, good tea, good meal, adequate furniture and electricity but *when he enters the factory or office, he becomes highly demanding* and likes everything to be in fine fettle. Further, every man from a sweeper to a manager has a sense of ego, individuality, and aspirations.

Under present conditions, the workers are getting frustrated as a result of their struggle for existence, shortages and low standard of living. Above all, the psychological complex resulting from poor leadership of their managers and supervisors has awfully hit the labour mind. Therefore, in formulating management philosophy and objectives, the basis should be the present labour psychology alongside general human considerations, not only on grounds of morality or humanitarianism but from the pragmatic viewpoint. An executive must always remain conscious of the fact that a worker wants

(a) treatment as an individual

(b) impartiality, sympathy and justice

(c) easy access to the boss

(d) quick disposal of his grievance

(e) fulfilment of his ego

(f) work to keep himself busy

(g) appreciation, identification and recognition

*Col. Bhattacharyya is a Senior Officer of the Indian Army, at present Commandant of 515 Army Base Workshop.

(h) full involvement of his boss in his task.

The goal of management must be to create throughout the enterprise a good society which offers satisfaction to the community. Before objectives could appeal to the individual, management has to develop a conscience.

Cooperation from men is essential to fulfil objectives; and **cooperation cannot be gained by demand**. "Every enterprise depends on cooperation" said Mr. Wilson: "In general Motors, we believe in *voluntary cooperation*".* In this context we may recall what Mr. Wilson calls the six basic principles of cooperation:

(a) Put the right people in the right places.

(b) Train everyone for the job to be done (motivation is also a function of performance and skill).

(c) Make the organisation a coordinated team.

(d) Supply the right tools and the right conditions.

(e) Give security with opportunity, incentive, recognition.

(f) Look ahead and plan ahead for more and better things for the men.

Participation Provides Satisfaction

"Workers' participation and motivation provide the psychological satisfaction that money cannot buy." Although many labour laws provide for consultation between management and workers through Works Committee, Plant Committee, Production Committee, Joint Council and even the Board of Directors, but the workers never developed a sense of participation due to their inadequate involvement in their own

organisation. There are many areas such as discipline, working conditions, wage fixation, sales promotion, profit sharing and welfare activities where labour can be made to get themselves fully involved. "Actions and reactions are equal, opposite and co-linear": this is the foundation of management philosophy with regard to workers' participation.

In many industries, workers do not like to participate in delicate areas, particularly where the 'shoe pinches' such as in a 'sick' industry. The executives are basically responsible to earn business, keep prices low, produce quality goods, provide good machinery and obtain satisfactory working conditions. It is only by sincerity, integrity and ability that management can easily win the confidence of workers. "The workers must feel that they are part of a worthwhile project and the project succeeded because their ability was needed in it. Money alone will not do the job."

Leadership and Motivation

"Motivation, like measles, is catching; but managers have to be in contact to catch it." To motivate labour, a manager must be one of them. Unless a leader fully involves himself in the work of his followers and stakes his personal pleasure for it, workers will not give their best. A worker likes to see his boss possessing responsibility and authority, setting personal example and identifying with him. The motivating force emanating from such a "worker-manager" relationship alone can be lasting and respectful.

Good 'climate', amongst a group of people working together, created by social environment, working conditions, intellectual opportunity and above all initimate supervision, is of paramount importance. Climate is the impact of all these factors; and the management provides most of this climate for the subordinates. The values of men come from the climate, culture and environment in which people move. Man develops satisfaction from the immediate factors which surround him in his work-place. Climate is, therefore, vital for morale.

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*Italics ours. This may remind knowledgeable readers of an interesting incident that happened at the First Disarmament Conference held under the auspices of the League of Nations after World War I. Herr Von Ribbentrop was the Foreign Minister of Germany; and a debate was going on whether enlistment in the army should be voluntary or compulsory: and Ribbentrop remarked: "What's the matter, gentlemen? In France it is compulsory, in England it is voluntary, *and in Germany it is voluntarily compulsory*."

A belief exists that unless one can 'hire and fire' employees, discipline cannot prevail in an organisation. This concept might have been true in the days of servitude; today it is an out-moded illusion. Fear is the crudest motive for getting some one to work, and probably the worst. If fear is the dominating factor it will take away all initiative from a worker. He will only think of doing just that much to avoid the 'whip'. Charge Sheets never bring discipline and a zeal to work. It is meant to be a preventive weapon. Once the charge sheet is issued, fear is gone which may lead to desperation. The motivating force can act effectively only during the 'preventive stage', and not at all at the 'desperation stage' as shown below:

```
                    C
                    H
                    A
                    R
                    G
                    E
Preventive stage         Desperation stage
←——————→             ←——————→
Motivate here       S    Motivation fails
                    H
                    E
                    E
                    T
```
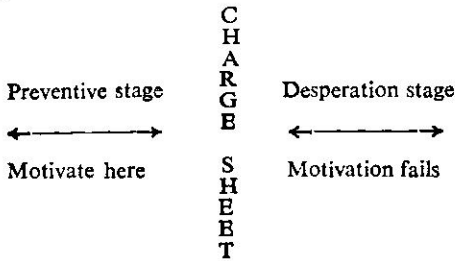
Morale is a state of mind by which one develops a will to work against dangers and difficulties. Industrial organisations continuously confront many odds. It is only by high morale amongst its workers that an organisation can sustain its smooth running and business progress. Morale is basically founded on mutual confidence in that the boss and the subordinate will get a square deal from each other, which has to be created and sustained by the laborious and conscious effort of management. In normal motivation cycle, leadership creates the work climate and furnishes the appropriate motivation; and this leads to high morale. The four elements of **leadership, motivation, climate** and **morale** in an industry are interlinked.

```
        W O R K   C L I M A T E
         ↑            ↑          ↓
         |            |          ↓
LEADERSHIP            |          MOTIVATION
         |            ↓          |
         ↓            ↓          ↓
        M    O    R    A    L    E
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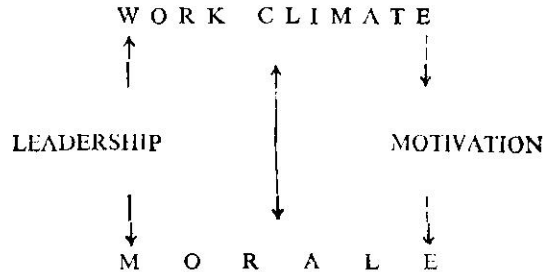
Conclusion

Every advanced country has developed a management conscience in relation to workers. In no country, money is at the apex of motivating forces. In India, where religion, culture, languages, political doctrine, sentiment, social custom, living conditions, are so divergent, it is only by good leadership that a healthy *espirit-de-corps* can be maintained in the sphere of industry. The most viable motivating force for labour in India is the leadership which can only be provided by enlightened industrial executives and management practitioners. ● ● ●

Output of Beauty and Truth

"... I cannot find evidence that the liberty of people has any effect, one way or the other, on a society's output of beauty and truth... isn't there something to be said for the idea that each great society has its creative 'culture' phase, followed by its sterile, 'civilised' phase, and that its political system is beside the point?..."

—Edward Hyams, *New Statesman*, 29 Aug. 1969

OFFICE

FULL AMENTIES GUARANTEED
NO FEAR OF HELL
STRAIGHT TO HEAVENS
COME TO OUR 'MURDAGHAT'

WE PAY CASH FOR
BURNING DEAD BODIES

राम राम राम राम राम राम

Vohra
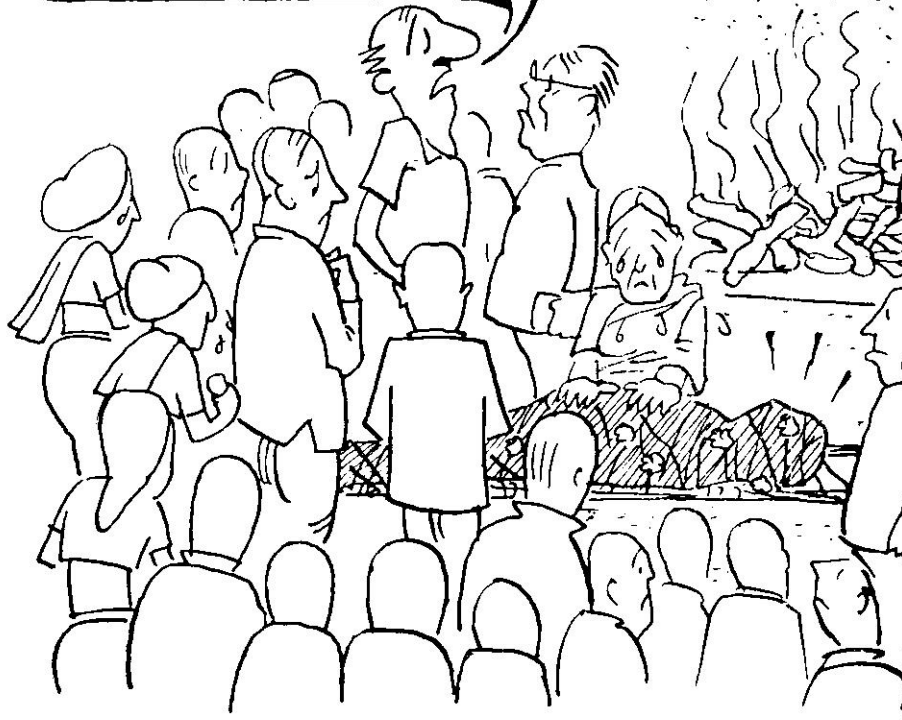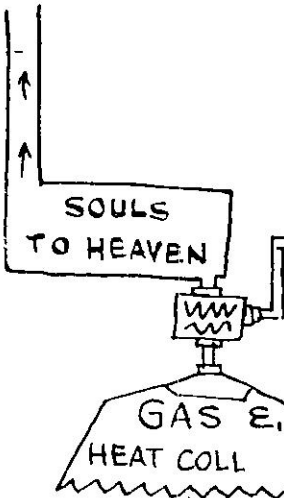
Technique
for
Labour Motivation

VSR Subramaniam*

Mr. Krishen Tanuja, Personnel Manager of Indian Dry Stuff Corporation, was wondering "why his labourers refuse to enrol in the Gratuity and Life Insurance scheme offering many BENEFITS?" During a discussion in January 1970, he said : "If there is resistance to automation, I see some logic in it. But why should there be such a resistance to a scheme which offers only benefits to workers and its giving up involves sacrifice of those benefits?" In India this is a common problem before many managements. Labour administration and successful policy implementation are the toughest assignments in developing countries. The author's study of such situations shows that the resistance is not due to the lower literacy status of workers, but because of lack of motivation from the management, as shown by the exposition of the case study referred to in the opening lines.

MOTIVATION DOES NOT MEAN TO EXERT MASS control over labourers through sub-conscious manipulation or tampering with people's emotions and running against psychological reactions due to resistance. Motivation is more a matter of strategy than manipulation. It is the process of arraying the logical forces so that labourers themselves decide to do what the management wants. The way the management deploys these forces would depend on

a. The type of labourers,
b. Their norms, maturity and understanding,
c. The technology of the given industrial set-up,
d. Management Policies, etc.

These impart a multi-dimensional shape to the concept of motivation. What is the right

*The author is a Systems Analyst in Mathematics, Computer and Systems Division of the ESSO Standard Eastern Inc., Bombay, India. This study, the first of its kind, relates to a public limited company where he was employed before. The name of the company is not disclosed. This study and the outcome suggest a systematic approach towards optimal utilisation of skilled manpower in Indian firms.

amount, kind and method of motivation? It is yet to enter into the thinking of many Indian company executives, as many of them are indivorceably wedded to the traditional approaches of hire and fire. However, the Personnel Manager in this case, Krishen Tanuja, had an open mind and, what is more important, the backing of the management. An opportunity offered itself for developing this new dimension to labour administration under typical Indian working conditions. The present study is the outcome of that experiment to design a common strategy to improve productivity.

The Indian Dry Stuff Corporation is a leading public unit in Western India. As a result of the quality and brand image, its products enjoy a monopoly position in the market.

As on April 30, 19..., there were 1309 employees in the rolls of the Company as shown in Exhibit 1. The daily-rated workmen were 89.8% of the work force and most of them belonged to the skilled or semi-skilled categories.

As per the speech of the Chairman recorded

Exhibit 1
EMPLOYEE COMPOSITION AS ON APRIL 30, 19...
Indian Dry Stuff Corporation
SOURCE : Personnel and Labour Office Records

No	Administrative Status	Chemicals Division	Inter-mediates	Fast Dyes Division	General Drystuff Plant	Total	% Distribu-tion
1.	Supervisory	5	4	3	3	15	1.30
2.	Clerical & Technical Staff	30	20	20	19	89	6.80
3.	Monthly Paid Apprentices (Confirmed)	10	6	7	5	28	2.10
4.	Daily-Rated Workmen	300	282	297	298	1177	89.80
	Total	345	312	327	325	1309	100.00

Exhibit 2
Indian Dry Stuff Corporation
Gratuity & Life Assurance Scheme—Life Insurance Corporation
INSURABILITY DISTRIBUTION OF EMPLOYEES
(As on June 30, 19...)

REF	Cadre	Directly Insurable Employees	Not Directly Insurable		Total
			Non Medical	Medical	
		1	2	3	
A	Supervisory	15	—	—-	15
B	Clerical & Technical Staff	32	26*	31*	89
C	(Monthly Paid Apprentices Confirmed)	—	20*	8*	28
D	Daily Rated Workmen	538	212	427	1177
	Total	585	258	466	1309

1. Automatically included in the scheme.
2. To complete Form 540 for being covered by the scheme.
3. To complete Form 580 & appear for a medical examination for being covered by the scheme.
† Attended the prescribed formalities & enrolled in the scheme.
D From 538 daily-rated workmen already covered, there was resistance through requests to remove their names from the scheme.
Out of 639 in Medical & Non Medical Category, only 28 attended the formalities in May 19... and enrolled in the Scheme (611 out of 639 remained out).

in the balance sheet for the financial year ending April 30, 1966, the management-employee relations were very cordial and satisfactory. There were no major strikes during the year. There was one recognized union, besides two others which were not recognized.

During 19..., the management proposed to adopt a scheme of Gratuity and Life Assurance. This scheme was designed by the Life Insurance Corporation of India. The objective of the scheme is to safeguard the interests of the dependents and bring them the fruits of gratuity in case of the death of an employee before the minimum stipulated period to get the full gratuity. The LIC has framed this scheme for industrial units in India, with the option left to management. This is administered by the "Trustees" comprising the representatives of the LIC and the Company management. In this case, after a series of discussions between the LIC and the Indian Dry Stuff Corporation, the scheme came into force as from May 1, 19....

In the Dry Stuff Company, the stipulated period to get gratuity, at the rate of one month's salary for each year of service, was 10 years. If any employee happened to die before this period, his dependents get only the pro-rated gratuity. After the introduction of this scheme, the dependents get 10 months full gratuity from the Life Insurance Corporation, even though the employee had completed only a few years of service at the time of death. The scheme was notified to the employees on June 30, 19..., through the Notice Board.

The scheme does not call for any premium payment from the employees. However, the insurability of the employees, is decided by the LIC based on the present salary, age, service and past medical records. Accordingly, the Insurance Corporation categorised the employees of the Dry Stuff Company under the following three categories:

a. 15 supervisory, 32 clerical/technical staff and 528 daily-rated workmen could be readily insured.

b. 26 clerical/technical staff, 20 monthly paid apprentices and 212 daily-rated workmen to fill Form 540 for evidence.

c. The remaining 466 persons to complete Form 580 and appear for a medical test.

This distribution is shown in Exhibit 2.

Employee Reaction

During December 19... (six months after the notification of the scheme) 57 clerical/ technical staff and 28 monthly paid apprentices attended the prescribed formalities and enrolled in the scheme. During the May of the following year (about one year after the introduction of the scheme) 28 daily-rated workmen attended the formalities and enrolled themselves in the scheme. During August 1967, the Personnel Manager organised a labour meeting and explained the benefits, but it was all in vain. In October 1967, he thought that the acceptance could come through the union. He called the Secretary of the recognized union and tried to convince him about the scheme. This meeting ended, with the conviction on the part of Krishen Tanuja that the Secretary himself did not meet the formalities nor was he prepared to understand the benefits.

After the meeting, in November a daily-rated workman already covered by the Gratuity and Life Assurance Scheme sent a letter to Krishen Tanuja to remove his name from the scheme as he was adequately covered by the regular Life Insurance.

Lack of Motivation

Next year when I was talking to the Personnel Manager, I was able to diagnose the presence of clear lack of labour motivation. The management-employee relationship appeared to be cordial, as there were no open strikes etc., but this unseen lack of motivation is more harmful to long-range cordiality. Adopting an analytical approach, the author designed a motivation strategy, as shown below:

i. Estimation of Labour Distribution Pattern

ii. Inter-action and Emergent Behaviour Analysis

iii. Assessment of Coefficient of Social Resistance

iv. Optimal Motivation Strategy.

A psychometric approach was adopted through-out the analysis. This approach quantifies the aspect of labour psychological reactions through numeric equivalents. Graphic techniques supplement the numerical analysis and highlight the action-needed areas.

Labour Distribution Pattern

The labour force in this company is made up of men of different ages, length of service, pay categories, ethnic backgrounds and engaged in different types of work. Although very little inter-action or group activity is required by the work itself, there are many non-job activities relating to their social organisation such as tea groups, union, card games, etc. In order to assess the significant factors encouraging such group formation, the author conducted sample surveys in different companies during 1964-65

and found that the most significant categories are the age, wage and job type.

An age-wage group analysis was in the Master Policy of the Gratuity and Life Assurance Scheme, to support the insurability of the persons in the Indian Dry Stuff Corporation. This is shown in Exhibit 3. The age group is from 20 to 60 years in intervals of 5 years. The wage groups are from Rs. 31 to Rs. 200 per month at intervals of Rs. 10. The major labour distribution was traced on a Concentrograph as shown in Exhibit 4. This leads to three important inferences on the labour distribution pattern:

i. The dominant wage group is in between Rs. 81 to Rs. 110 per month;

ii. The dominant age groups are in the order of (a) 26 to 30 years, (b) 31 to 35 years and (c) 20 to 25 years;

iii. Other age and wage group concentrations are insignificant.

Exhibit 3
LABOUR AGE & WAGE GROUP DISTRIBUTION PATTERN
Indian Dry Stuff Corporation
(January 31, 19...)

Wage Group Rs.	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-110	111-120	121-130	131-140	141-150	151-160	161-170	171-180	181-190	191-200	Total
Age Group	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	
20—25	30	22	20	29	21	12	141	6	3	4	2	—	—	—	—	—	—	290
26—30	16	26	27	37	75	50	251	22	16	7	1	3	—	1	—	—	1	533
31—35	8	22	12	13	28	11	57	11	15	6	4	—	2	1	1	1	2	194
36—40	1	13	9	8	7	9	12	4	6	13	2	—	—	—	—	—	—	84
41—45	—	4	4	4	5	3	8	5	5	4	3	2	—	—	—	—	—	47
46—50	—	1	—	5	—	1	2	1	1	1	—	—	—	—	—	—	—	12
51—55	—	—	1	1	—	1	5	2	1	3	—	—	—	—	—	—	—	14
56—60	—	—	—	—	—	—	2	1	—	—	—	—	—	—	—	—	—	3
Total	55	88	73	97	136	87	478	52	47	38	12	5	2	2	1	1	3	1,117

Source : Master Policy GI/21068 and covering list —Life Insurance Corporation of India. (Policy Number Disguised)

EXHIBIT-4

LABOUR AGE-WAGE GROUP CONCENTRO GRAPH

(DOMINANT GROUPS)
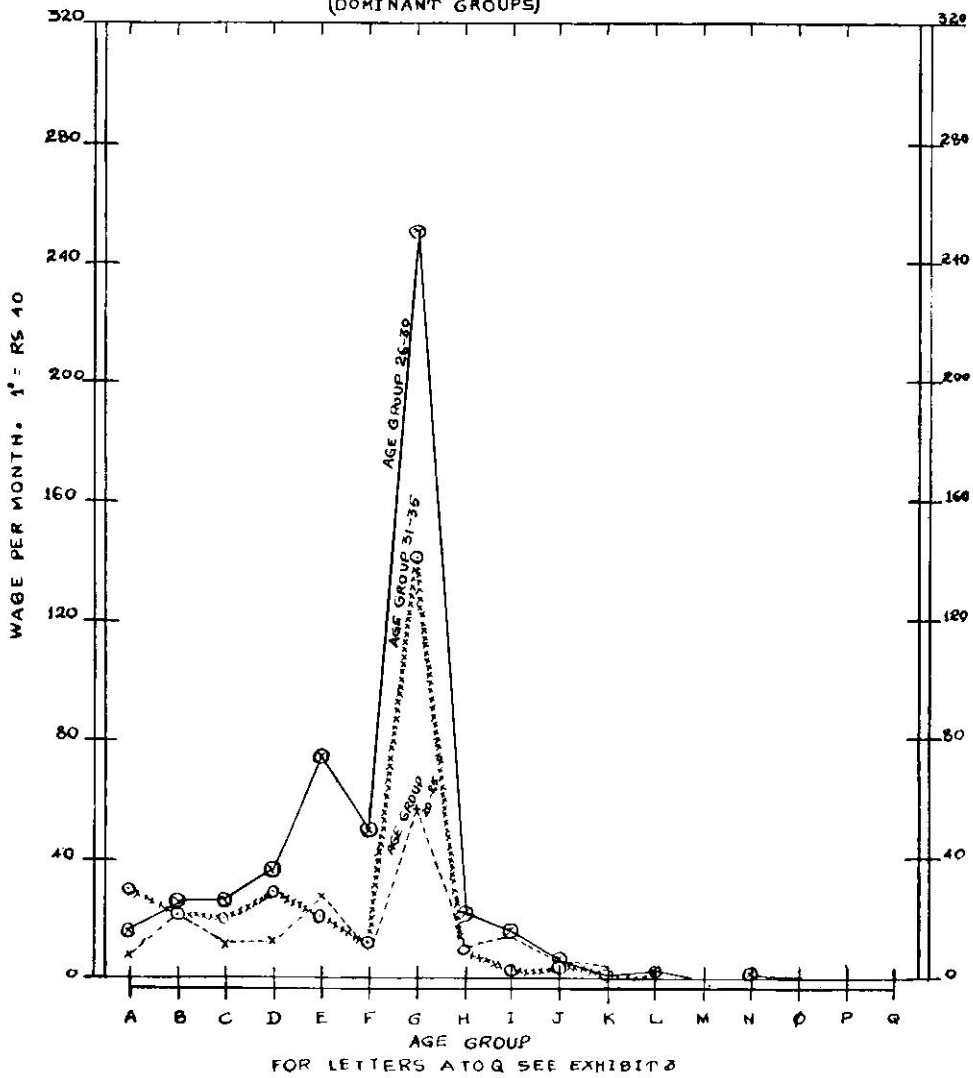
Inter-Action and Emergent Behaviour Analysis

Persons in different age and wage groups when working together develop ways of thinking and behaving that are different from, or super-imposed on to the behaviour which is required to perform a given job. Let this emergent behaviour be represented by E in a suitable comparative work performance percentage unit. The contributing factors are:

(a) "Individual behaviour (I)" which every human being possesses by birth, growth and self-development. This is in direct relationship to E.

(b) 'Required Behaviour (R)" as called by the rules and regulations of a company or work place. This bears an indirect relationship to E, due to the common psychological force of resistance to change.

(c) "Group Behaviour (G)" due to persons of different geographic origin, linguistic background, religious outlook, eating habits, political patterns, etc. are forced into one work group. This is highly significant under Indian working conditions. Due to the group norms and influence of dominant members, many lose their individual identity.* This bears a direct relationship to E.

Hence the Emergent Behaviour E could be mathematically** related with I, R and G as

$$E = F\left[\frac{(I.G)}{R}\right] = A\left[\frac{NI^a \times MG^b}{R^c}\right] + U$$

where A is the constant of proportionality, U is the influence of random factors, N is the number of labourers, and M is the number of identifiable groups; a, b, c are the elasticity coefficients of I, G, R respectively, relative to E. Using this relationship, it is possible to establish a relationship for a given labour group for a

limited period. By feeding test values for E, N, I, M, G, and R, a computer programme is developed to get the values of A, U, a, b and c.

Another way of doing this will be to get the compound effect on E due to I, R and G through an "Inter-action Analysis". The author spent one full month in identifying the dominant groups and estimating the direction of degree of interaction.
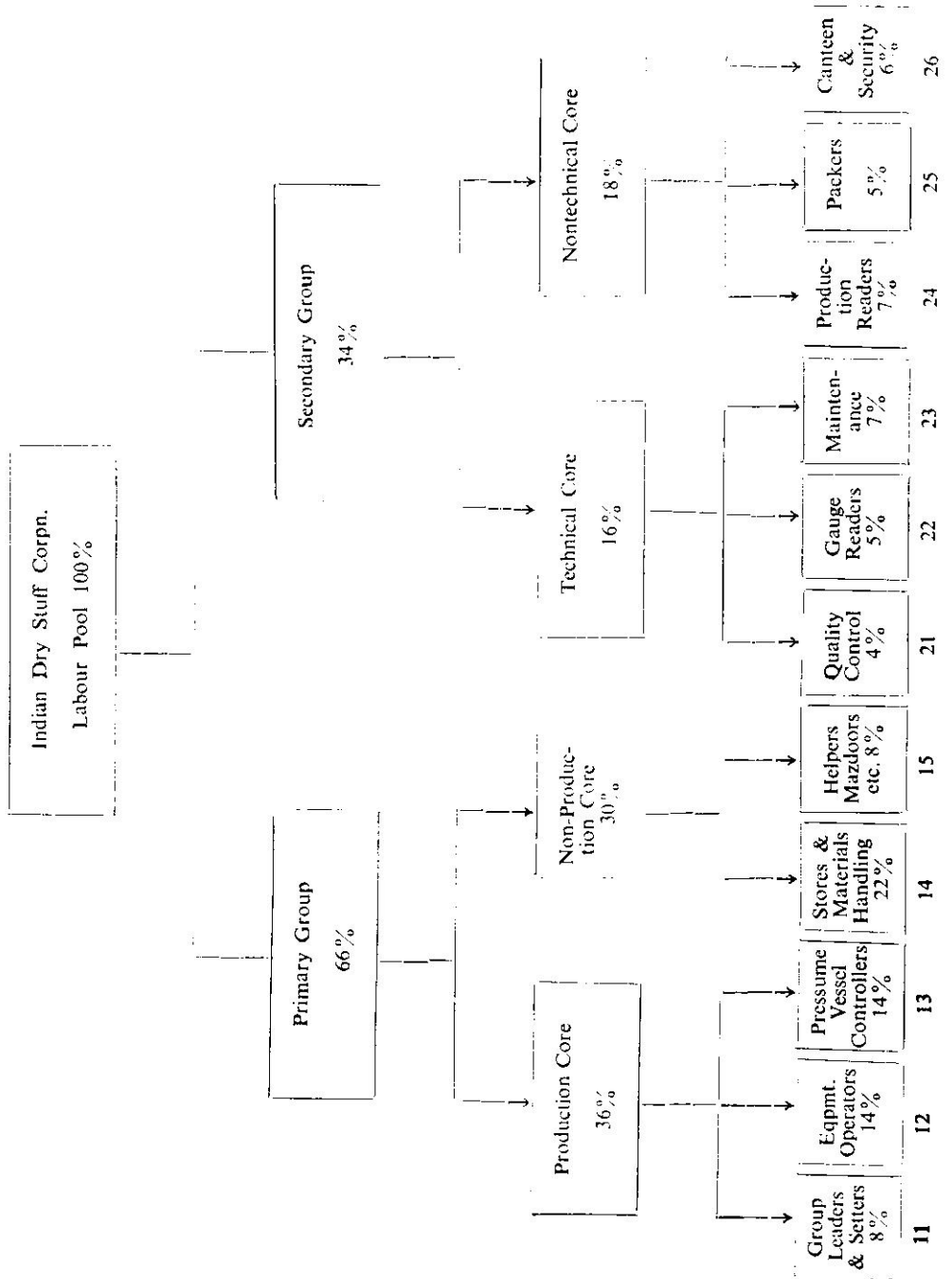
From the point of technology there are two main groups in the Dry Stuff Company, each being made up of many sub-groups.

(a) A "Primary Group" with 66% of the labour force. This is made up of 36% production core and 30% of non-production core. The production core is made up of Equipment Operators, Pressure Vessel Operators and Group Leaders, Setters. The non-production core is made up of Stores, Materials Handling Group, and Helpers, Mazdoor Group.

(b) The "Secondary Group" with 34% of labour force. This is made up of a technical core with 16%, and a non-technical core with 18% membership. The technical core comprises Quality Control, Gauge Readers, Maintenance sub-groups. The non-technical core is made up of Production Recorders, Packers, and Canteen, Security groups.

The sub-group and membership densities are shown in Exhibit 5. Due to the common technology, it was found that the sub-groups always go together, discuss, and contribute their decisions and reactions to the Primary and Secondary groups and ultimately to the Emergent Behaviour of the "Workmen Pool" of the Indian Dry Stuff Corporation.

The comparative literary and social status of the Primary Group is lower than that of the Secondary Group. The required behaviour or the management policies are discussed individually by the sub-groups. The Primary Group conveys

*In my surveys, I found, particularly, labourers from Southern India who lost their self-identity factors like the mother-tongue, eating habits and religious outlook due to their necessity to move towards job opportunities, and influence of local groups.

**Developed and tested by the author.

Exhibit 5

LABOUR SOCIAL SUB-GROUPS & MEMBERSHIP DENSITY

their reactions to the Secondary group. The Secondary Group considers them and expresses certain reactions. The reactions of the Primary and the Secondary Group contribute ultimately to the general labour behaviour, at the Indian Dry Stuff Corporation. These are graphically shown in the "Labour Reaction & Behaviour Graph" in Exhibit 6.

Assessment of Coefficient of Social Resistance

Having studied the "Group formation" and flow of "Interaction" among labour groups, it is necessary to assess the understanding of the particular scheme by these groups. A questionnaire with 25 relevant aspects of the scheme was prepared. A random selection of 100 workers was made from each sub-group, proportional to the membership as below:

Group Leaders and Setters	8
Equipment Operators	14
Pressure Vessel Controllers	14
Stores and Materials handling	22
Helpers and Mazdoors	8
Quality Control Group	4

EXHIBIT-6

LABOUR INTER-ACTION & EMERGENT BEHAVIOUR GRAPH
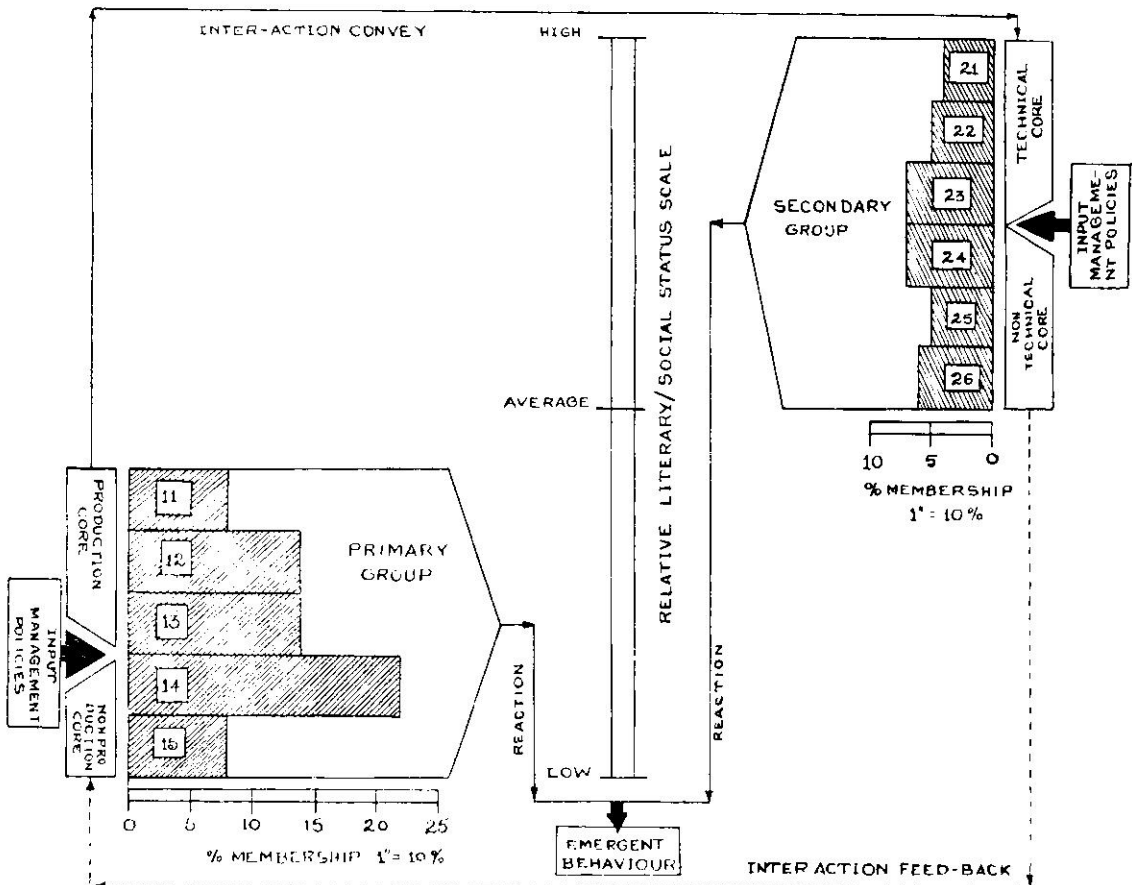
Gauge Readers	5
Maintenance Group	7
Production Recorders	7
Packers	5
Canteen & Security Group:	6
Total	100 workers

In order to avoid any bias in selecting particular individuals, a random number table was used. The five-digit random number was used as the "Pay Roll Ticket Number". Then without prior intimation these workers were contacted at random and their answers to the pre-set questions were recorded. For an answer towards a better understanding, 1 or 2 marks were awarded; neutral answers or silence were graded as zero; and an answer towards misunderstanding was graded as either -1 or -2. The total score of the 100 workmen was analysed on a five-point scale: the result was as below.

Understanding	Score Range	Number of Workers
Highly misunderstood	-50 to -30	6
No understanding	-29 to -10	19
Average knowledge	-9 to $+10$	38
Commendable	$+11$ to $+30$	37
Thorough knowledge	$+31$ to $+50$	Nil
	Total	100

This distribution is plotted in an "Understanding Distribution Graph" as shown in Exhibit 7.

This distribution is used to derive the coefficient of social resistance.* This could be defined as the "Product of the percentage failure of a given management policy, and the ratio of the number of persons who have at least an average knowledge of the policy to the total number of persons interviewed for a social survey through an unbiased sampling procedure."

According to this, let us assume that there are n persons who have at least an understanding of a management policy out of N persons interviewed in an unbiased survey, and if x persons do not respond favourably to the scheme out of total persons y, then the percentage failure of the scheme is $\frac{x}{y} \times 100 = F\%$. The coefficient of Social Resistance is $S = \frac{n}{x} \times F$.

This coefficient S is an index to represent the degree of influence of failure F over n persons out of N, who know the policy.

At the Indian Dry Stuff Corporation, 611 out of 639 workers remained unenrolled in the Gratuity and Life Assurance Scheme (See Exhibit 2) or the failure is $\frac{611}{639} \times 100 = 95.45\%$ (F). In the above sample survey, the number of persons having at least an average knowledge of the scheme was 75 (n) out of 100 (N) persons interviewed. Hence the coefficient of Social Resistance for the Corporation was $S = \frac{75}{100} \times 95.45 = 71.59$.

This is too high and reflects the probability of serious management-labour misunderstanding.

EXHIBIT 7

Policy Understanding Distribution Graph

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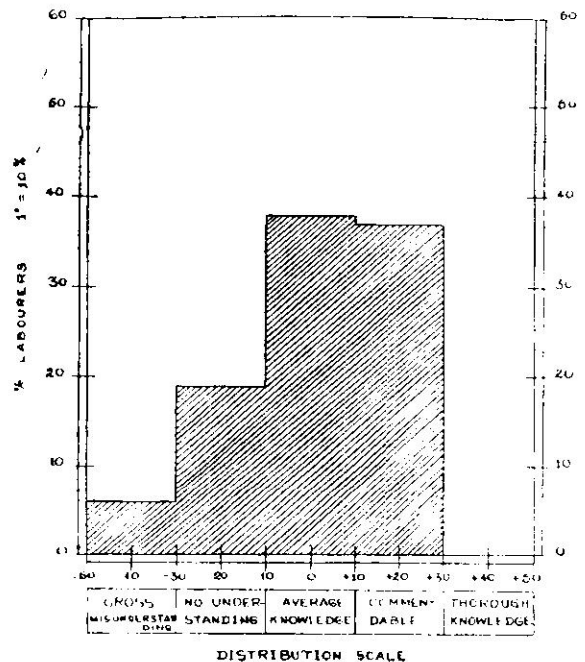
* A mathematical index developed by the author

Optimal Motivation Strategy

Making use of the inferences of this study using "Gratuity and Life Assurance Scheme", the following optimal motivational strategy was designed towards successful implementation of management policies, providing adequate social incentive to improve productivity.

i. Before implementing any policy, arrange for a get-together with randomly selected workers in the age group 20-35 in the wage group Rs. 81 to 110 per month. Explain the scheme to them especially the financial implications and benefits. This is equivalent to an appeal to the dominant age and wage group in the social ladder. If they exhibit signs of acceptance, then the policy will be successfully conveyed to the major labour group; if not, it should be modified and a fresh attempt made to carry conviction to this dominant group.

ii. Provide adequate incentive to attend external part/full-time educational facilities especially to Group Leaders, Setters, Equipment Operators, Pressure Vessel Controllers and persons in Stores and Materials Handling. They enjoy a primary group status, though a backward literacy status. This is the reason for a high failure ratio for the given scheme. Also organise a Training-Within-Industry Scheme to make the workers aware of the Company's policies, and its management, the importance of productivity and its role should be emphasised. Use demonstrative cases, films and lectures.

iii. When the workers have to fill some forms like 540 and 580 in the Gratuity and Life Assurance Scheme, allocate a clerk to assist them to complete the forms accurately.

iv. Encourage better group interaction by organising a sports club, and improve employee communication through a house magazine. Ease work tension by encouraging dramatic/music activities during holidays and auspicious days.

v. Attempt through these means to popularise the Gratuity and Life Assurance Scheme. Then reframe these general guidelines for popularising any future policies.

Conclusion

"The spirit of a business is the test of quality of Personnel Management through the morale of all concerned with it" was the definition given by the British Institute of Management. Optimal utilisation of manpower calls for appropriate motivation, for each individual is equipped with a mind to think and to feel. Of course, workers' psychology can also be a subject of study; and the analytical steps involved are rendered easy by the computer. The implementation is left to the management.

The study outlined here brought successful results during subsequent years. If more firms could use this technique towards tuning themselves to the reaction of workers, it will be the "take off stage" for improved productivity and better management-employee relations.●●●
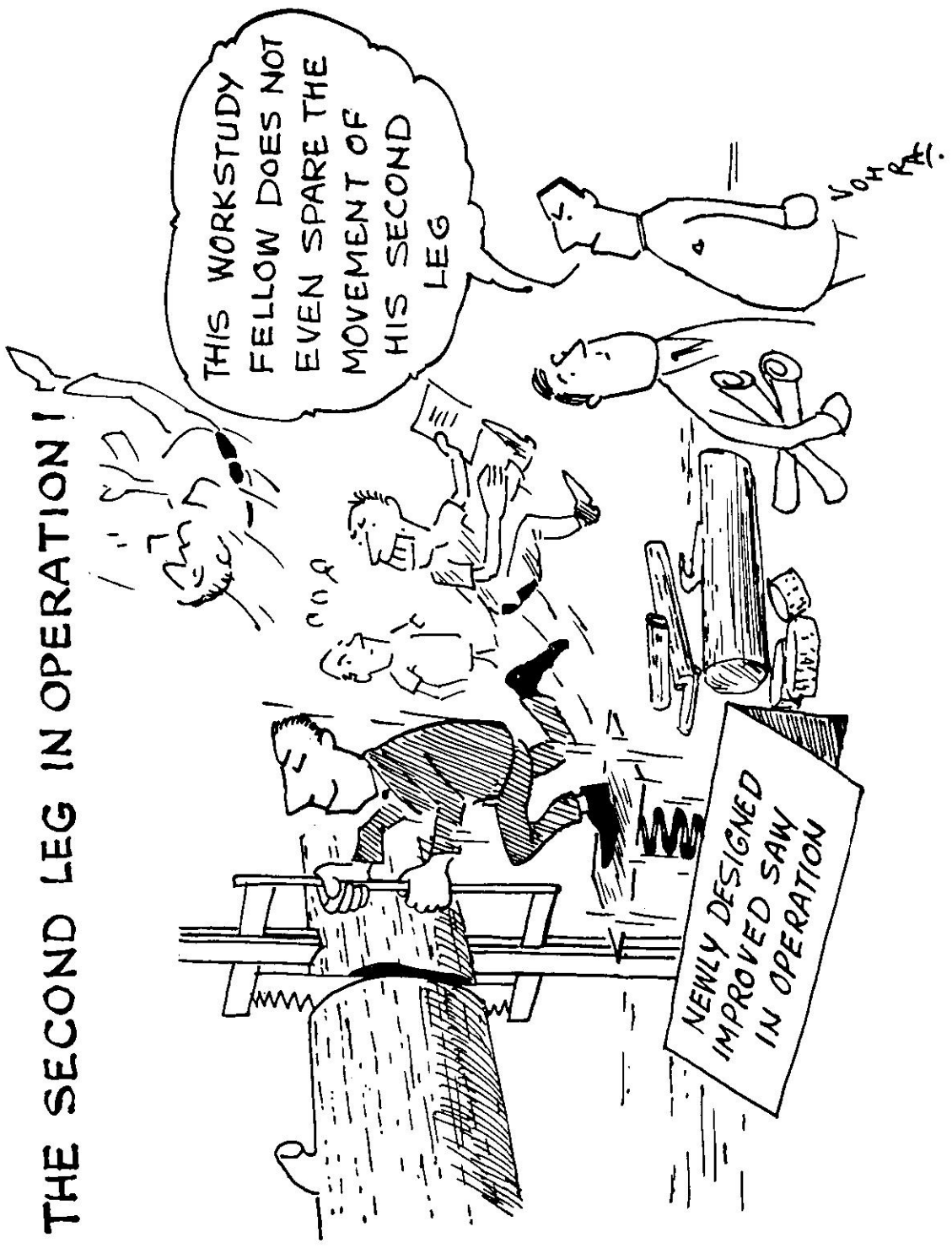
Dustbin Incentive Bonus

Since an incentive bonus scheme was introduced for dustmen at Taunton, Somerest, a year ago, the men have emptied the bins so fast that the dustcarts have overheated and broken down, a Council Report says.

—*The Times* (London)

THE SECOND LEG IN OPERATION!

Wage-Profit Differentials in Indian Industries

SS Ahluwalia & Sharwan Kumar*

The present study is in continuation of the earlier study by the authors entitled "Wage-Productivity Differentials in Indian Industries—1963"[1]. In that study an attempt was made to measure the variation between industries and between States in respect of various characteristics like value added. productive capital, wages and benefits both per worker and per manhour through the use of analysis of variance and co-variance.

THE PRESENT STUDY, LIKE THE EARLIER ONE, is based on all the 203 industries covered under the census sector of the Annual Survey of Industries, 1963. Here two additional characteristics, viz., gross profits and depreciation (both measured again in terms of workers and manhours) have been analysed singly and in conjuction with the variables considered earlier, viz., value added, productive capital and wages and benefits.

Tables 1 to 4 give variation between States and between industries for depreciation and gross profit per worker and per manhour. The analysis of variance reveals that the variation in all the cases is statistically highly significant at 1% level of significance. As observed for other variables, in the earlier study, the variation per manhour is less marked than that in the case of per worker.

Covariance has been studied among the following set of combinations:

1. Gross profit and value added (per worker)
2. Gross profit and value added (per manhour)
3. Gross profit and productive capital (per worker)
4. Gross profit and productive capital (per manhour)
5. Gross profit and wages & benefits (per worker)
6. Gross profit and wages & benefits (per manhour)
7. Depreciation and gross profit (per worker)
8. Depreciation and gross profit (per manhour)
9. Depreciation and productive capital (per worker)
10. Depreciation and productive capital (per manhour)

For each of these combinations, tests of significance for regression line, tests of significance of industrial mean effects and tests of significance of States mean effects have been studied. It would be interesting to note that in all cases all the three tests of significance are statistically highly significant at 1% level of significance. The results of analysis of covariance between the above given sets of combinations along with the tests of significance are given in Tables 5 to 14.

Tables 15 and 16 give the values of the various ratios and their ranks for all India and States averages in respect of gross profit and depreciation, both measured per worker and per manhour, for all the 203 industries.

It would be interesting to observe that the first three highest positions for gross profit (per worker and per manhour) are amongst the industries, petroleum refining, tyres and tubes, fine chemicals including photographic chemicals, dye stuffs and non-ferrous basic metal industries. Similarly in respect of depreciation, four industries, from amongst which three highest positions are occupied, are petroleum refining, textile auxiliary and sizing meterial, fine chemicals, including photographic chemicals and synthetic resins, plastics etc.

The three lowest ranks, in case of gross profit, are from among the industries cashewnut processing, bidi, cotton textiles, cotton ginning; cleaning and processing, lac including shellac; rice, dal and flour mill machinery, tramway works and slates and slate products. The corresponding industries in the case of depreciation are rice mills, canning and preserving of fruits and vegetables, dal mills, cashewnut processing; bidi and cigar manufacturing.

Highest rank for gross profit (per worker and per manhour) is observed in the case of Maharashtra for all the industries taken together. The corresponding depreciation provision is highest in case of Orissa. The various ratios along with their ranks, for different states, are given in Table 17.

The coefficients of rank correlation between different sets of characteristics have been studied for all-India and States averages. The values of rank correlation coefficients are given in Table 18. The interesting point to note, here, is that in all cases the coefficients are statistically highly significant at 1% level of significance. The value of the coefficient is observed to be highest between gross profit and value added (both per worker and per manhour) implying thereby that the industries with the highest value added have the highest gross profits as well. It would be further observed that the values of the rank correlation coefficients are consistently higher in the case of all-India as compared to States averages. Similarly, values of the rank correlation coefficients measured per worker are consistently higher than those in the case of per manhour, both in the case of all-India and States averages.

TABLE 1
ANALYSIS OF VARIANCE—DEPRECIATION PER WORKER

Due to	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	'F' Ratio
1	2	3	4	5
States	43.290	20	2.164	10.110
Industry	2691.239	202	13.322	62.230
Error	864.927	4040	.214	
Total	3599.458	4262		

TABLE 2
ANALYSIS OF VARIANCE —GROSS PROFIT PER WORKER

Due to	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	'F' Ratio
1	2	3	4	5
States	802.550	20	40.127	14.365
Industry	33935.641	202	167.998	60.144
Error	11284.745	4040	2.793	
Total	46022.936	4262		

TABLE 3
ANALYSIS OF VARIANCE—DEPRECIATION PER MANHOUR

Due to	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	'F' Ratio
1	2	3	4	5
States	9.467	20	.473	6.853
Industry	499.549	202	2.473	35.306
Error	279.026	4040	.069	
Total	788.043	4262		

TABLE 4
ANALYSIS OF VARIANCE—GROSS PROFIT PER MANHOUR

Due to	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	'F' Ratio
1	2	3	4	5
States	151.502	20	7.575	9.794
Industry	5936.421	202	29.388	37.998
Error	3124.550	4040	.773	
Total	9212.473	4262		

TABLE 5B
TEST OF SIGNIFICANCE OF INDUSTRIES MEAN EFFECTS

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
Industry +Error	1149.625	4241		
Error	418.335	4039	.103	
Difference	731.289	202	3.620	34.953

TABLE 5
ANALYSIS OF COVARIANCE—GROSS PROFIT AND VALUE ADDED PER WORKER

Due to	Degrees of Freedom	Y^2	YZ	Z^2	B	B.YZ	Residual Sum of Squares
1	2	3	4	5	6	7	8
States	20	802.550	722.151	673.782	.89982	649.806	23.975
Industry	202	33935.641	27174.532	22466.002	.80076	21760.450	705.542
Error	4040	11284.745	9658.683	8685.262	.85590	8266.926	418.335
State + Error	4060	12087.295	10380.834	9359.044	.85882	8915.287	443.756
Industry + Error	4242	45220.386	36833.215	31151.264	.81452	30001.639	1149.625

TABLE 5A
TEST OF SIGNIFICANCE OF REGRESSION LINE

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
Regression	8266.926	1	8266.926	79816.579
Error	418.335	4039	.103	

TABLE 5C
TEST OF SIGNIFICANCE OF STATES MEAN EFFECTS

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
State +Error	443.756	4059		
Error	418.335	4039	.103	
Difference	25.420	20	1.271	12.271

TABLE 6

ANALYSIS OF COVARIANCE—GROSS PROFIT AND VALUE ADDED PER MANHOUR

Due to	Degrees of Freedom	Y^2	YZ	Z^2	B	B.YZ	Residual Sum of Squares
1	2	3	4	5	6	7	8
States	20	151.502	137.122	128.244	.90508	124.107	4.136
Industry	202	5936.421	4820.103	4036.490	.81195	3913.703	122.786
Error	4040	3124.550	2621.925	2278.193	.83913	2200.154	78.038
State + Error	4060	3276.052	2759.048	2406.438	.84218	2323.633	82.804
Industry + Error	4242	9060.971	7442.028	6314.683	.82132	6112.346	202.337

TABLE 6A

TEST OF SIGNIFICANCE OF REGRESSION LINE

Due of	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
Regression	2200.154	1	2200.154	113871.74
Error	78.038	4039	.019	

TABLE 6B

TEST OF SIGNIFICANCE OF INDUSTRY MEAN EFFECTS

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
Industry + Error	202.337	4241		
Error	78.038	4039	.019	
Difference	124.298	202	.615	31.847

TABLE 7

ANALYSIS OF COVARIANCE—GROSS PROFIT AND PRODUCTIVE CAPITAL PER WORKER

Due to	Degrees of Freedom	Y^2	YZ	Z^2	B	B.YZ	Residual Sum of Squares
1	2	3	4	5	6	7	8
States	20	802.550	1576.930	9590.690	1.96489	3098.508	6492.181
Industry	202	33935.641	97540.660	476782.860	2.87428	280359.520	196423 340
Error	4040	11284.745	16979.380	171636.640	1.50463	25547.704	146088.940
State + Error	4060	12087.295	18556.310	181227.330	1.53519	28487.483	152739.850
Industry + Error	4242	45220.386	114520.040	648419.500	2.53248	290020.510	358398.990

TABLE 6 C

TEST OF SIGNIFICANCE OF STATES MEAN EFFECTS

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
State+ Error	82.804	4059		
Error	78.038	4039	.019	
Difference	4.765	20	.238	12.331

TABLE 7 B

TEST OF SIGNIFICANCE OF INDUSTRIES MEAN EFFECTS

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
Industry+ Error	358398.990	4241		
Error	146088.940	4039	36.169	
Difference	212310.050	202	1051.039	29.058

TABLE 7 A

TEST OF SIGNIFICANCE OF REGRESSION LINE

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
Regression	25547.704	1	25547.704	706.331
Error	146088.940	4039	36.169	

TABLE 7 C

TEST OF SIGNIFICANCE OF STATES MEAN EFFECTS

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
State+ Error	152739.850	4059		
Error	146088.940	4039	36.169	
Difference	6650.910	20	332.545	9.194

TABLE 8

ANALYSIS OF COVARIANCE–GROSS PROFIT AND PRODUCTIVE CAPITAL PER MANHOUR

Due to	Degrees of Freedom	Y^2	YZ	Z^2	B	B.YZ	Residual Sum of Squares
1	2	3	4	5	6	7	8
States	20	151.502	311.266	1833.006	2.05453	639.506	1193.499
Industry	202	5936.421	17314.785	84872.300	2.91670	50502.107	34370.193
Error	4040	3124.550	7979.076	52788.404	2.55367	20375.942	32412.462
State + Error	4060	3276.052	8290.342	54621.410	2.53058	20979.449	33641.961
Industry + Error	4242	9060.971	25293.861	137660.700	2.79151	70608.260	67052.440

TABLE 8A

TEST OF SIGNIFICANCE OF REGRESSION LINE

Due to	Sum of Squares	Degrees of Free-dom	Mean Squares	'F' Ratio
1	2	3	4	5
Regression	20375.942	1	20375.942	2539.098
Error	32412.462	4039	8.024	

TABLE 8C

TEST OF SIGNIFICANCE OF STATES MEAN EFFECTS

Due to	Sum of Squares	Degrees of Free-dom	Mean Squares	'F' Ratio
1	2	3	4	5
State+ Error	33641.961	4059		
Error	32412.462	4039	8.024	
Difference	1229.499	20	61.474	7.660

TABLE 8B

TEST OF SIGNIFICANCE OF INDUSTRIES MEAN EFFECTS

Due to	Sum of Squares	Degrees of Free-dom	Mean Squares	'F' Ratio
1	2	3	4	5
Industry+ Error	67052.440	4241		
Error	32412.462	4039	8.024	
Difference	34639.978	202	171.485	21.369

TABLE 9A

TEST OF SIGNIFICANCE OF REGRESSION LINE

Due to	Sum of Squares	Degrees of Free-dom	Mean Squares	'F' Ratio
1	2	3	4	5
Regression	42.076	1	42.076	716.998
Error	239.028	4039	.059	

TABLE 9

ANALYSIS OF COVARIANCE—GROSS PROFITS AND WAGES AND BENEFITS PER WORKER

Due to	Degrees of Freedom	Y^2	YZ	Z^2	B	B.YZ	Residual Sum of Squares
1	2	3	4	5	6	7	8
States	20	802.550	133.843	43.036	.16677	22.321	20.715
Industry	202	33935.641	2782.217	623.647	.08198	228.100	395.546
Error	4040	11284.745	689.077	281.105	.06106	42.076	239.028
State + Error	4060	12087.295	822.920	324.141	.06808	56.025	268.115
Industry + Error	4242	45220.386	3471.294	904.752	.07676	266.470	638.281

TABLE 9B
TEST OF SIGNIFICANCE OF INDUSTRY MEAN EFFECTS

Due to	Sum of Squares	Degrees of Free-dom	Mean Squares	'F' Ratio
1	2	3	4	5
Industry + Error	638.281	4241		
Error	239.028	4039	.059	
Difference	399.253	202	1.976	33.398

TABLE 10A
TEST OF SIGNIFICANCE OF REGRESSION LINE

Due to	Sum of Squares	Degrees of Free-dom	Mean Squares	'F' Ratio
1	2	3	4	5
Regression	44.577	1	44.577	2932.503
Error	61.397	4039	.015	

TABLE 9C
TEST OF SIGNIFICANCE OF STATES MEAN EFFECTS

Due to	Sum of Squares	Degrees of Free-dom	Mean Squares	'F' Ratio
1	2	3	4	5
State + Error	268.115	4059		
Error	239.028	4039	.059	
Difference	29.087	20	1.454	24.575

TABLE 10B
TEST OF SIGNIFICANCE OF INDUSTRY MEAN EFFECTS

Due to	Sum of Squares	Degrees of Free-dom	Mean Squares	'F' Ratio
1	2	3	4	5
Industry + Error	139.808	4241		
Error	61.397	4039	0.15	
Difference	78.411	202	.388	25.536

TABLE 10
ANALYSIS OF COVARIANCE—GROSS PROFIT AND WAGES AND BENEFITS PER MANHOUR

Due to	Degrees of Freedom	Y^2	YZ	Z^2	B	B.YZ	Residual Sum of Squares
1	2	3	4	5	6	7	8
States	20	151.502	26.745	8.263	.17653	4.721	3.542
Industry	202	5936.421	505.310	119.011	.08512	43.012	75.999
Error	4040	3124.550	373.207	105.974	.11944	44.577	61.397
State + Error	4060	3276.052	399.952	114.238	.12208	48.827	65.410
Industry + Error	4242	9060.971	878.517	224.986	.09695	85.177	139.808

TABLE 10C

TEST OF SIGNIFICANCE OF STATES MEAN EFFECT

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
State + Error	65.410	4059		
Error	61.397	4039	.015	
Difference	4.013	20	.200	13.201

TABLE 11B

TEST OF SIGNIFICANCE OF MEAN INDUSTRIES EFFECTS

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
Indust. + Error	25326.807	4241		
Error	8564.211	4039	2.120	
Difference	16762.596	202	82.983	39.135

TABLE 11A

TEST OF SIGNIFICANCE OF REGRESSION LINE

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
Regression	2720.534	1	2720.534	1283.041
Error	8564.211	4039	2.120	

TABLE 11C

TEST OF SIGNIFICANCE OF STATES— MEAN EFFECTS

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Rati
1	2	3	4	5
State + Error	9067.840	4059		
Error	8564.211	4039	2.120	
Difference	503.629	20	25.181	11.875

TABLE 11

ANALYSIS OF COVARIANCE—DEPRECIATION AND GROSS PROFIT PER WORKER

Due to	Degrees of Freedom	Y^2	YZ	Z^2	B	B.YZ	Residual Sum of Squares
1	2	3	4	5	6	7	8
States	20	43.290	122.026	802.550	2.81876	343.963	458.586
Industry	202	2691.239	6877.028	33935.641	2.55533	17573.133	16362.508
Error	4040	864.927	1533.970	11284.745	1.77352	2720.534	8564.211
State + Error	4060	908.218	1655.997	12087.295	1.82334	3019.455	9067.840
Industry + Error	4242	3556.167	8410.998	45220.386	2.36518	19893.579	25326.807

TABLE 12

ANALYSIS OF COVARIANCE—DEPRECIATION AND GROSS PROFIT PER MANHOUR

Due to	Degrees of Freedom	Y²	YZ	Z²	B	B.YZ	Residual Sum of Squares
1	2	3	4	5	6	7	8
States	20	9.467	26.524	151.502	2.80163	74.311	77.190
Industry	202	499.549	1221.802	5936.421	2.44580	2988.291	2948.129
Error	4040	279.026	649.137	3124.550	2.32643	1510.175	1614.374
State + Error	4060	288.493	675.661	3276.052	2.34203	1582.419	1693.632
Industry + Error	4242	778.576	1870.939	9060.971	2.40302	4495.915	4565.055

TABLE 12A

TEST OF SIGNIFICANCE OF REGRESSION LINE

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
Regression	1510.175	1	1510.175	3778.305
Error	1614.374	4039	.399	

TABLE 12B

TEST OF SIGNIFICANCE OF INDUSTRIES MEAN EFFECTS

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
Indust. + Error	4565.055	4241		
Error	1614.374	4039	.399	
Difference	2950.680	202	14.607	36.546

TABLE 12C

TEST OF SIGNIFICANCE OF STATES— MEAN EFFECTS

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
State + Error	1693.632	4059		
Error	1614.374	4039	.399	
Difference	79.258	20	3.962	9.914

TABLE 13

ANALYSIS OF COVARIANCE—PRODUCTIVE CAPITAL AND DEPRECIATION PER WORKER

Due to	Degrees of Freedom	Y^2	YZ	Z^2	B	B.YZ	Residual Sum of Squares
1	2	3	4	5	6	7	8
States	20	9590.690	522.147	43.290	.05444	28.427	14.863
Industry	202	476782.860	27344.719	2691.239	.05735	1568.289	1122.950
Error	4040	171636.640	6055.974	864.927	.03528	213.677	651.250
State + Error	4060	181227.330	6578.121	908.218	.03629	238.770	669.448
Industry + Error	4242	648419.500	33400.693	3556.167	.05151	1720.500	1835.666

TABLE 13A

TEST OF SIGNIFICANCE OF REGRESSION LINE

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
Regression	213.677	1	213.677	1325.206
Error	561.250	4039	.161	

TABLE 13B

TEST OF SIGNIFICANCE OF INDUSTRY MEAN EFFECTS

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
Industry + Error	1835.666	4241		
Error	651.250	4039	.161	
Difference	1184.415	202	5.863	36.364

TABLE 13C

TEST OF SIGNIFICANCE OF STATE MEAN EFFECTS

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
State + Error	669.448	4059		
Error	651.250	4039	.161	
Difference	18.197	20	.909	5.642

TABLE 14

ANALYSIS OF COVARIANCE– PRODUCTIVE CAPITAL AND DEPRECIATION PER MANHOUR

Due to	Degrees of Freedom	Y^2	YZ	Z^2	B	B.YZ	Residual Sum of Squares
1	2	3	4	5	6	7	8
States	20	1833.006	113.618	9.467	.06198	7.042	2.424
Industry	202	84872.300	4970.393	499.549	.05868	292.254	207.295
Error	4040	52788.404	2664.007	279.026	.05046	134.441	144.585
State + Error	4060	54621.410	2777.625	288.493	.05085	141.248	147.245
Industry + Error	4242	137660.700	7644.460	778.576	.05553	424.499	354.076

TABLE 14A
TEST OF SIGNIFICANCE OF REGRESSION LINE

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
Regression	134.441	1	134.441	3755.625
Error	144.585	4039	.035	

TABLE 14B
TEST OF SIGNIFICANCE OF INDUSTRY MEAN EFFECT

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
Industry + Error	354.076	424'		
Error	144.585	4039	.035	
Difference	209.491	202	1.037	28.971

TABLE 14C
TEST OF SIGNIFICANCE OF STATE MEAN EFFECTS

Due to	Sum of Squares	Degrees of Freedom	Mean Squares	'F' Ratio
1	2	3	4	5
State + Error	147.245	4059		
Error	144.585	4039	.035	
Difference	2.659	20	.132	3.715

TABLE 15

GROSS PROFIT PER WORKER AND PER MANHOUR FOR DIFFERENT INDIAN INDUSTRIES, 1963

Sl. No.	Industry	All-India				States			
		per worker		per manhour		per worker		per manhour	
		value	rank	value	rank	value	rank	value	rank
1	2	3	4	5	6	7	8	9	10
1	slaughtering, preparation & preserving of meat & other miscellaneous food preparations	5.5	77	2.7	64	5.6	69	2.5	69
2	milk food & malted foods	8.6	41	3.3	47	8.5	41	3.3	50
3	canning & preserving of fruits & vegetables	3.2	140	1.4	142	3.0	137	1.3	144
4	canning & preserving of fish & other sea foods	4.7	94	1.6	125	4.7	85	1.6	111
5	flour mills	6.0	64	2.5	69	6.1	63	2.5	68
6	rice mills	1.6	185	0.9	181	1.6	191	0.8	186
7	dal mills	2.5	162	1.1	162	2.6	158	1.1	162
8	bakery products	7.3	51	3.0	56	6.0	64	2.5	67
9	sugar	5.4	79	2.2	83	6.2	62	2.5	66
10	gur	2.3	170	1.5	131	1.7	189	0.9	177
11	manufacture of cocoa, chocolate & sugar confectionery	5.4	78	2.3	78	5.2	75	2.3	73
12	manufacture of edible oils (other than hydrogenated oils)	3.7	122	1.6	124	3.0	136	1.3	143
13	hydrogenated oil (vanaspati)	9.5	33	3.8	39	10.0	30	4.0	33
14	tea manufacture	4.5	99	1.9	102	8.6	39	3.7	41
15	coffee curing works	1.1	192	0.6	194	0.9	200	0.5	200
16	cashewnut processing	0.7	197	0.3	200	0.8	201	0.3	203
17	starch	9.3	36	3.4	44	8.2	44	3.0	57
18	cold storage	3.2	139	1.3	150	2.0	180	0.8	185
19	salt	2.1	174	1.0	171	1.8	182	0.9	176
20	distilling, rectifying & blending of spirits (alcohol)	4.8	90	2.0	93	5.1	79	2.3	72
21	wine industries	2.8	151	1.0	170	2.8	146	1.0	169
22	breweries & manufacturing of malt	11.6	19	5.1	17	16.9	7	8.0	6
23	soft drinks & carbonated water industries	11.2	23	4.7	21	12.4	15	5.2	17
24	biri	0.9	194	0.4	198	1.0	198	0.4	201
25	cigar	1.4	189	0.6	193	1.4	197	0.6	199
26	cigarettes	16.6	8	7.6	6	16.6	9	6.9	9
27	snuff	6.4	59	2.8	59	6.4	60	2.8	61
28	zerda	3.1	142	1.4	141	2.8	145	1.3	142
29	other tobacco manufactures	0.8	195	0.8	186	1.9	181	1.2	152
30	cotton textiles	0.3	199	0.1	201	2.7	150	1.1	161
31	jute textiles	2.7	155	1.0	169	2.1	174	0.8	184
32	woollen textiles	4.9	89	2.0	92	2.5	160	1.0	168
33	silk	1.0	193	0.4	197	1.5	195	0.6	198
34	art silk	6.0	63	2.4	75	5.5	71	2.2	78
35	webbing narrow fabrics, embroidery & lace manufactures	3.4	130	1.5	130	3.4	124	1.4	132
36	textiles dyeing, bleaching, finishing & processing including mercerising, finishing, calendering, glazing, proofing etc.	3.2	138	1.3	149	2.7	149	1.1	160

1	2	3	4	5	6	7	8	9	10
37	thread and thread ball making	6.9	55	3.0	55	6.7	57	2.9	58
38	carpet weaving	1.7	183	0.8	185	1.4	196	0.6	197
39	knitting mills (hosiery & other knitted goods)	3.3	134	1.4	140	3.7	112	1.5	123
40	cordage, rope & twine industries manufacture of textiles n.e.c.	3.7	121	1.6	123	3.0	135	1.3	141
41	cotton ginning, cleaning and pressing	0.0	203	0.0	203	0.9	199	0.7	191
42	jute pressing	2.8	150	4.9	20	2.8	144	4.9	19
43	wool balling and pressing	2.4	164	1.4	139	2.4	162	1.4	131
44	coir manufacture	2.3	169	1.0	168	2.3	167	1.0	167
45	artificial leather & oil cloth and linoleum and similar products	4.6	96	1.9	101	5.2	74	2.1	83
46	gas mantles & manufacture of textiles n.e.c. others	4.9	88	2.1	85	4.9	81	2.1	82
47	tarpaulins, tents, sails and other made up canvas goods	3.3	133	1.4	138	3.4	123	1.4	130
48	manufacture of footwear	3.0	144	1.3	148	3.8	106	1.7	100
49	clothing and tailoring and others	2.3	168	0.9	180	1.7	188	0.7	190
50	umbrella manufacture	2.0	179	0.9	179	2.1	173	0.9	175
51	saw milling	2.0	178	0.9	178	2.5	159	1.1	159
52	plywood	3.6	125	1.4	137	3.1	129	1.3	140
53	wooden & cane containers & cane smallware	2.9	147	1.2	158	2.8	143	1.1	158
54	joinery & general wood working	2.4	163	1.0	167	2.6	157	1.2	151
55	cork & wood products n.e.c. others	2.6	158	1.2	157	2.9	140	1.4	129
56	manufacture of fixtures & fixture wooden	1.3	190	0.5	196	1.7	187	0.7	189
57	manufacture of furniture & fixtures—metal & others	4.3	104	1.9	100	2.6	156	1.1	157
58	pulp-woodpulp, mechanical, chemical, including dissolving pulp, paper: writing, printing, wrapping & newsprint	7.5	49	2.7	63	7.5	51	4.1	31
59	paper board and straw board	5.1	84	1.9	99	5.1	78	1.9	90
60	paper for packaging (corrugated paper, kraft paper, paper bags, paper containers, etc.)	5.5	76	2.3	77	4.5	89	1.9	89
61	hardboard including fibre board & chipboard	11.3	21	4.6	24	11.3	21	4.6	23
62	manufacture of paper & paper products & others	5.9	67	2.5	68	8.9	36	3.8	38
63	letter press & lithographic printing & book binding	4.2	107	1.9	98	3.9	101	1.7	99
64	other printing including photography	4.2	106	1.8	108	3.8	105	1.7	98
65	tanneries & leather finishing plants	3.2	137	1.3	147	2.0	179	1.5	122
66	manufacture of leather products except footwear and other wearing apparel	4.0	111	1.6	122	4.0	96	1.6	110
67	tyres and tubes	24.8	2	10.4	3	23.0	3	9.4	3
68	surgical & medicinal products including prophylactics & manufacture of rubber products—others	4.4	103	1.8	107	4.2	94	1.8	93
69	rubber footwear	5.2	82	2.3	76	6.4	59	2.6	64
70	mixed-fertilizers	6.6	57	3.5	42	6.3	61	3.7	40
71	inorganic fertilizers	12.3	14	5.0	18	16.6	8	6.2	13
72	inorganic heavy chemicals	11.1	25	4.1	31	11.5	18	4.3	26
73	synthetic resins & plastics & synthetic rubber	20.1	4	7.5	7	19.3	5	7.3	7
74	organic heavy chemicals	19.3	5	8.4	4	19.9	4	8.6	5
75	man-made fibres including regenerated cellulose, rayon, nylon etc.	18.4	6	6.9	8	18.4	6	6.9	8

1	2	3	4	5	6	7	8	9	10
76	explosives including gun-powder and safety fuses	6.4	58	2.7	62	10.0	29	3.9	35
77	dye stuffs	20.3	3	8.2	5	15.5	10	6.3	12
78	turpentine and resin products of fermentation industries other than alcohol and other basic industrial chemicals	14.3	9	5.4	15	14.8	13	5.6	16
79	vegetable oils including solvent extracted oils	3.9	113	1.6	121	3.9	100	1.6	109
80	paints, varnishes and lacquers	11.1	24	4.9	19	10.6	24	4.7	21
81	glue & gelatine & waxes & polishes etc. (for leather, wood, metal, glasses, etc.)	7.0	54	3.1	50	7.0	55	3.1	55
82	fine chemical including photographic chemicals	9.7	32	40.2	1	9.7	31	15.9	2
83	insecticides, fungicides & weedicides	8.2	43	3.3	46	10.3	27	4.0	32
84	textile auxiliaries & sizing materials	11.2	22	5.1	16	11.2	22	5.1	18
85	manufacture of miscellaneous chemical products etc.	9.7	31	4.2	30	8.0	46	3.5	45
86	drugs and pharmaceuticals	13.9	13	6.1	10	9.4	32	4.1	30
87	soaps and glycerine	17.0	7	6.8	9	14.4	14	5.9	15
88	perfumes, cosmetics & other toilet preparations	12.2	16	5.6	13	10.5	25	4.8	20
89	matches	4.2	105	1.8	106	5.5	70	2.3	71
90	lac including shellac	0.0	202	1.3	146	0.0	203	1.3	139
91	petroleum refineries	50.1	1	20.6	2	45.3	1	18.6	1
92	manufacture of miscellaneous products of petroleum & coal	12.2	15	4.4	26	11.5	17	4.4	24
93	fire bricks	1.2	191	0.7	189	2.3	166	0.8	183
94	refractories & furnace lining bricks, —acidic, basic & natural	4.9	87	1.8	105	4.2	93	1.5	121
95	tiles	2.0	177	0.8	184	2.3	165	1.0	166
96	glass hollowware	1.4	188	0.5	195	1.5	194	0.6	196
97	sheet and plate glass	4.5	98	1.6	120	4.5	88	1 6	108
98	glass wool & miscellaneous glassware	2.2	172	0.9	177	2.1	172	0.8	182
99	laboratory glassware	2.6	157	1.0	166	2.6	165	1.0	165
100	chinaware and pottery	2.1	173	0.8	183	2.0	178	0.8	181
101	sanitaryware and whiteware	2.8	149	1.1	161	2.9	139	1.2	150
102	insulators	2.3	167	0.9	176	2.7	148	1.1	156
103	manufacture of cement (hydraulic)	10.2	30	3.8	38	10.4	26	3.8	37
104	asbestos cement	8.9	40	3.1	49	8.9	35	3.1	54
105	hume pipe & other cement & concrete products (including reinforced products)	2.7	154	1.2	156	3.0	134	1.3	138
106	stone dressing and crushing	2.3	166	1.0	165	2.1	171	0.9	174
107	grinding wheels and abrasives	12.1	17	4.6	23	11.3	20	4.2	28
108	mica factories	1.5	187	0.6	192	1.5	193	0.6	195
109	manufacture of non-metallic mineral products n.e.c., other	10.7	28	4.3	29	7.7	48	3.1	53
110	iron and steel (metal)	10.6	29	4.0	33	6.7	56	2.6	63
111	ferro-alloys	11.7	18	4.3	28	11.3	19	4.1	29
112	iron & steel castings & forgings	3.3	132	1.4	136	2.6	154	1.0	164
113	iron and steel structurals	4.4	102	1.9	97	3.8	104	1.6	107
114	iron and steel pipes	7.3	50	3.0	54	9.3	33	3.8	36
115	non-ferrous basic metal industries	13.9	12	5.5	14	23.1	2	8.8	4
116	metal containers & steel trunks	5.6	74	2.4	74	4.6	86	2.0	86
117	cutlery, locks etc.	2.3	165	0.9	175	2.0	177	0.8	180
118	bolts, nuts, nails, screws, springs, chains, etc.	6.3	61	2.7	61	3.9	99	1.6	106
119	enamelling, japaning & lacquering, galvanising, plating & polishing metal products	2.9	146	1.2	155	2.0	176	0.8	179

1	2	3	4	5	6	7	8	9	10
120	type-founding	3.8	117	1.7	115	3.8	103	1.7	97
121	welding	3.7	120	1.5	129	3.6	116	1.5	120
122	safes and vaults	1.7	182	0.7	188	1.7	186	0.7	188
123	razor blades	14.2	10	5.9	11	5.6	68	5.9	14
124	hurricane lanterns	2.5	161	1.0	164	2.3	164	0.9	173
125	hand tools and small tools	7.6	48	3.2	48	7.7	47	3.2	52
126	metal fittings for shoes & leather articles and wearing apparel	3.6	124	1.5	128	3.6	115	1.5	119
127	sanitary & plumbing fixtures & fittings for metals	3.1	141	1.3	145	3.1	128	1.3	137
128	weights & manufacture of metal products except machinery and transport equipment—others	4.7	93	2.0	91	3.7	111	1.6	105
129	boilers and steam generating plants	8.0	45	3.6	40	8.0	45	3.6	42
130	internal combustion engines	5.6	73	2.4	73	4.8	84	2.0	85
131	textile machinery (such as spinning frames, carding machines, power looms etc., including textile)	4.7	92	2.0	90	3.6	114	1.5	118
132	jute machinery	9.2	37	3.9	36	9.2	34	3.9	34
133	sugar machinery	3.9	112	1.7	114	3.9	98	1.7	96
134	tea machinery	5.5	75	2.0	89	4.4	91	1.7	95
135	mining machinery	3.5	129	1.5	127	3.9	97	1.6	104
136	metallurgical machinery & cement machinery	4.4	101	1.9	96	4.4	90	1.9	88
137	chemical machinery	3.8	116	1.6	119	3.7	110	1.6	103
138	pharmaceutical machinery	2.7	153	1.1	160	2.7	147	1.1	155
139	paper machinery	8.5	42	3.5	41	8.5	40	3.5	44
140	construction machinery	3.7	119	1.6	118	3.8	102	1.6	102
141	oil mill machinery	3.8	115	1.6	117	3.6	113	1.5	117
142	rice, dal & flour mill machinery	0.2	201	1.2	154	2.4	161	1.2	149
143	size reduction equipment, crushes, ball mill etc.	2.8	148	1.2	153	2.8	142	1.2	148
144	conveying equipment: bucket elevators skip hoists, cranes, derricks, etc.	5.2	81	2.2	82	6.6	58	2.8	60
145	mixers & reactors — kneading mills, turbomixers, etc. and centrifugal machinery	4.9	86	2.2	81	4.9	80	2.2	77
146	power driven pumps reciprocating centrifugal etc.	5.0	85	2.0	88	3.7	109	1.5	116
147	air & gas compressors & vacuum pumps (excluding electrical furnaces)	9.4	34	3.9	35	8.8	38	3.5	43
148	refrigeration plants for industrial use	5.1	83	2.2	80	5.1	77	2.2	76
149	fire fighting equipment & appliances including fire engine	3.3	131	1.4	135	3.3	125	1.4	128
150	ball roller & tapered bearing & speed reduction units	8.0	44	3.0	53	8.3	42	3.2	51
151	machine tools	5.7	70	2.5	67	4.1	95	1.8	92
152	tractors, harvestors, etc.	3.5	128	1.5	126	3.4	122	1.4	127
153	agricultural implements	4.0	110	1.7	113	4.5	87	1.9	87
154	earth moving machinery & fork lift trucks etc.	4.6	95	1.9	95	4.2	92	1.8	91
155	typewriters and duplicators	11.5	20	4.6	22	11.5	16	4.6	22
156	calculation machines & other commercial office and household equipments	3.5	127	1.8	104	3.7	108	2.1	81
157	airconditioners and refrigerators	4.0	109	1.7	112	3.5	119	1.5	115
158	sewing and knitting machines	5.9	66	2.6	65	5.8	66	2.6	62
159	weighing machines	7.6	47	3.4	43	7.6	50	3.4	47
160	machinery except electrical machinery —others	4.1	108	1.7	111	3.0	133	1.2	147

1	2	3	4	5	6	7	8	9	10
161	equipment for generation, transmission & distribution of electricity including transformers								
162	electrical motors	4.5	97	2.0	87	3.4	121	1.5	114
163	electrical fans	9.1	38	3.9	34	14.8	12	6.3	11
164	electrical lamps	6.3	60	2.8	58	3.1	127	1.4	126
165	manufacture of electrical furnaces, x-ray equipments, electrical machinery, apparatus, appliances & supplies—others	5.9	65	2.4	72	5.4	73	2.2	75
166	electrical cable and wire	3.0	143	1.4	134	3.5	118	1.6	101
167	household appliances such as electric irons, heaters etc.	13.9	11	5.8	12	14.8	11	6.4	10
168	storage batteries	3.2	136	1.3	144	2.8	141	1.2	146
169	dry cells	10.9	27	4.3	27	10.9	23	4.3	25
170	telephone	7.2	53	2.8	57	7.2	54	2.8	59
171	telegraph equipment & teleprinters	5.7	69	2.5	66	5.7	67	2.5	65
172	wireless communication apparatus & radio receivers including amplifying & public address equipments	3.5	126	1.4	133	3.7	107	1.5	113
173	ships and other vessels drawn by power	5.6	72	2.4	71	4.8	83	2.1	80
174	boat building	3.7	118	1.6	116	2.9	138	1.3	136
175	railway locomotives	1.8	180	0.8	182	1.7	185	0.3	178
176	railway rolling stock	3.2	135	1.4	132	3.0	132	1.3	135
177	tramway works	3.8	114	1.7	110	3.1	126	1.4	125
178	manufacture of motor vehicles	0.2	200	0.0	202	1.7	184	0.6	194
179	repair of motor vehicles	8.9	39	3.8	37	8.2	43	3.4	46
180	manufacture of motorcycles & bicycles and manufacture of transport equipment n.e.c.	2.5	160	1.0	163	2.2	170	0.9	172
181	manufacture of aircraft	5.6	71	2.4	70	4.8	82	2.1	79
182	surgical instruments	11.0	26	4.5	25	8.8	37	3.7	39
183	water meters, steam metres & electricity meters	2.6	156	1.2	152	2.6	153	1.2	145
184	industrial instruments indicating recording & regulating devices for pressure, temperature, rate of flow weights, levels etc.	7.2	52	3.3	45	7.2	53	3.3	49
185	scientific instruments	9.3	35	4.0	32	10.0	28	4.2	27
186	mathematical surveying & drawing instruments	3.6	123	1.7	109	3.4	120	1.7	94
187	photographic printing papers & manufacture of photographic and optical goods—others	6.0	62	2.7	60	5.4	72	2.4	70
188	manufacture of watches and clocks	0.4	198	1.8	103	2.2	169	1.4	124
189	jewellery	6.7	56	3.0	52	7.3	52	3.3	48
190	mints	5.2	80	2.2	79	5.1	76	2.2	74
191	manufacture of musical instruments	5.8	68	2.0	86	5.8	65	2.0	84
192	pen and pencil making	2.0	176	0.9	174	2.0	175	0.9	171
193	fountain pen manufacturing	2.7	152	1.2	151	3.5	117	1.5	112
194	button making	2.5	159	1.1	159	2.6	152	1.1	154
195	manufacturing of ice	7.6	46	3.0	51	7.6	49	3.0	56
196	plastic moulded goods	1.6	184	0.6	191	1.6	190	0.6	193
197	celluloid articles & manufacturing industries n.e.c.—others	4.4	100	1.9	94	3.0	131	1.3	134
198	brooms and brushes	4.7	91	2.1	84	3.0	130	1.3	133
199	games and sports goods	2.9	145	1.3	143	2.6	151	1.1	153
200	toy manufacturing	2.2	171	0.9	173	2.2	168	0.9	170
201	wrapping, packing, filling, etc. of articles	1.7	181	0.7	187	1.7	183	0.7	187
202	bones, ivory, horns, hoofs, claws and similar products (bone crushing)	2.0	175	0.9	172	2.3	163	1.0	163
203	slates and slate products	1.5	186	0.6	190	1.5	192	0.6	192
		0.7	196	0.3	199	0.7	202	0.3	202

TABLE 16

Depreciation per Worker and per Manhour for Different Indian Industries - 1963

Sl. No.	Industry	All - India				States			
		per worker		per manhour		per worker		per manhour	
		value	rank	value	rank	value	rank	value	rank
1	2	3	4	5	6	7	8	9	10
1	slaughtering, preparation & preserving of meat & other miscellaneous food preparations	0.3	121	0.1	138	0.3	118	0.1	14
2	milk food and malted foods	1.5	24	0.6	27	1.5	22	0.6	23
3	canning & preserving of fruits and vegetables	0.2	145	0.0	203	0.2	144	0.0	203
4	canning & preserving of fish & other sea foods	0.5	77	0.1	137	0.5	75	0.1	139
5	flour mills	0.5	76	0.2	81	0.6	61	0.2	80
6	rice mills	0.0	203	0.0	202	0.1	179	0.0	202
7	dal mills	0.1	177	0.0	201	0.1	178	0.0	201
8	bakery products	0.3	120	0.1	136	0.2	143	0.1	138
9	sugar	0.8	51	0.3	56	1.2	32	0.5	33
10	gur	0.2	144	0.1	135	0.1	177	0.0	200
11	manufacture of cocoa, chocolate & sugar confectionery	0.1	176	0.0	200	0.1	176	0.0	199
12	manufacture of edible oils (other than hydrogenated oils)	0.3	119	0.1	134	0.3	117	0.1	137
13	hydrogenated oil (vanaspati)	0.9	41	0.3	55	1.2	31	0.4	43
14	tea manufacturing	0.4	92	0.2	80	0.3	116	0.1	136
15	coffee curing works	0.1	175	0.0	199	0.1	175	0.0	198
16	cashewnut processing	0.0	202	0.0	198	0.0	203	0.0	197
17	starch	1.3	30	0.4	38	1.0	41	0.3	55
18	cold storage	1.4	27	0.6	26	1.2	30	0.5	32
19	salt	0.1	174	0.0	197	0.1	174	0.0	196
20	distilling rectifying & blending of spirits (alcohol)	0.6	66	0.2	79	0.5	74	0.2	79
21	wine industries	0.6	65	0.2	78	0.7	55	0.2	78
22	breweries & manufacturing of malt	0.8	50	0.3	54	1.2	29	0.5	31
23	soft drinks & carbonated water industries	0.7	59	0.3	53	0.8	51	0.3	54
24	biri	0.0	201	0.0	196	0.0	202	0.0	195
25	cigar	0.0	200	0.0	195	0.0	201	0.0	194
26	cigarettes	0.4	91	0.2	77	0.4	93	0.1	135
27	snuff	0.1	173	0.0	194	0.1	173	0.0	193
28	zerda	0.0	199	0.0	193	0.0	200	0.0	192
29	other tobacco manufactures	0.0	198	0.0	192	0.0	199	0.0	191
30	cotton textiles	0.3	118	0.1	133	0.3	115	0.1	134
31	jute textiles	0.1	172	0.0	191	0.1	172	0.0	190
32	woollen textiles	0.4	90	0.1	132	0.2	142	0.1	133
33	silk	0.2	143	0.0	190	0.5	73	0.2	77
34	art silk	0.8	49	0.3	52	0.8	50	0.3	53
35	webbing narrow fabrics, embroidery & lace manufacturing	0.2	142	0.1	131	0.2	141	0.1	132
36	textiles dyeing, bleaching, finishing & processing including mercerizing, finishing, calendering, glazing, proofing etc.	0.3	117	0.1	130	0.4	92	0.1	131
37	thread and thread ball making	0.6	64	0.2	76	0.5	72	0.2	76
38	carpet weaving	0.0	197	0.0	189	0.0	198	0.0	189

1	2	3	4	5	6	7	8	9	10
39	knitting mills (hosiery & other knitted goods)	0.1	171	0.0	188	0.1	171	0.0	188
40	cordage, rope & twine industries, manufacture of textiles n.e.c	0.2	141	0.0	187	0.1	170	0.0	187
41	cotton ginning, cleaning and pressing	0.0	196	0.0	186	0.0	197	0.0	186
42	jute pressing	0.1	170	0.1	129	0.1	169	0.1	130
43	wool balling and pressing	0.0	195	0.0	185	0.0	196	0.0	185
44	coir manufacture	0.0	194	0.0	184	0.0	195	0.0	184
45	artificial leather & oil cloth & linoleum & similar products	0.5	75	0.2	75	0.5	71	0.2	75
46	gas mantles & manufacture of textiles n.e.c.—others	0.3	116	0.1	128	0.3	114	0.1	129
47	tarpaulins, tents, sails & other made up canvas goods	0.0	193	0.0	183	0.0	194	0.0	183
48	manufacture of footwear	0.0	192	0.0	182	0.0	193	0.0	182
49	clothing and tailoring and others	0.0	191	0.0	181	0.0	192	0.0	181
50	umbrella manufacture	0.1	169	0.0	180	0.1	168	0.0	180
51	saw milling	0.1	168	0.0	179	0.1	167	0.0	179
52	plywood	0.5	74	0.2	74	0.4	91	0.1	128
53	wooden & cane containers & cane smallware	0.1	167	0.0	178	0.1	166	0.0	178
54	joinery & general wood-working	0.1	166	0.0	177	0.1	165	0.0	177
55	cork and wood products n.e.c.—others	0.2	140	0.1	127	0.3	113	0.1	127
56	manufacture of furniture & fixtures wooden	0.0	190	0.0	176	0.0	191	0.0	176
57	manufacture of furniture & fixtures—metal & others	0.3	115	0.1	126	0.2	140	0.0	175
58	pulp-wood pulp, mechanical, chemical including dissolving pulp, paper: writing, printing & wrapping; and newsprint	1.6	23	0.6	25	1.9	18	1.1	13
59	paper board and straw board	0.7	58	0.2	73	0.6	60	0.2	74
60	paper for packaging (corrugated paper, kraft paper, paper bags, paper containers, etc.)	0.4	89	0.2	72	0.4	90	0.1	126
61	hard board including fibre board & chipboard	2.7	11	1.1	12	2.7	11	1.1	12
62	manufacture of paper & paper products—others	0.3	114	0.1	125	0.6	59	0.2	73
63	letter press & lithographic printing & book binding	0.3	113	0.1	124	0.2	139	0.1	125
64	other printing including photography	0.1	165	0.0	175	0.1	164	0.0	174
65	tanneries & leather finishing plants	0.1	164	0.0	174	0.1	163	0.1	124
66	manufacture of leather products except footwear & other wearing apparel	0.4	88	0.1	123	0.4	89	0.1	123
67	tyres & tubes	2.0	18	0.8	19	3.8	8	1.5	9
68	surgical & medicinal products including prophylactics, & manufacture of rubber products—others	0.4	87	0.1	122	0.3	112	0.1	122
69	rubber footwear	0.1	163	0.0	173	0.1	162	0.0	173
70	mixed fertilizers	0.3	112	0.1	121	0.3	111	0.2	72
71	inorganic fertilizers	4.8	6	1.9	7	5.4	5	2.0	8
72	inorganic heavy chemicals	2.2	15	0.8	18	2.0	16	0.7	21
73	synthetic resins & plastics & synthetic rubber	7.9	3	2.9	4	8.0	3	3.0	4
74	organic heavy chemicals	5.1	5	2.2	6	5.3	7	2.3	7
75	man-made fibres including regenerated cellulose, rayon, nylon etc.	3.6	8	1.3	10	3.6	9	1.3	11
76	explosives including gun-powder & safety fuses	1.8	22	0.7	22	3.3	10	1.3	10

1	2	3	4	5	6	7	8	9	10
77	dye stuffs	3.0	10	1.2	11	2.1	15	0.8	17
78	turpentine & rosin products of fermentation industries other than alcohol & other basic industrial chemicals	2.2	14	0.8	17	2.3	13	0.8	16
79	vegetable oils, including solvent extracted oils	1.0	37	0.4	37	1.0	40	0.4	42
80	paints, varnishes and lacquers	0.4	86	0.1	120	0.4	88	0.1	121
81	glue & gelatine & waxes & polishes etc. (for leather, wood, metal, glass etc.)	1.4	26	0.6	24	0.5	70	0.2	71
82	fine chemical including photographic chemicals	3.0	9	12.5	1	1.3	26	4.2	2
83	insecticides, fungicides and weedicides	0.7	57	0.3	51	0.3	110	0.1	120
84	textile auxiliaries & sizing materials	25.1	1	11.3	2	15.2	1	6.9	1
85	manufacture of miscellaneous chemical products etc.	1.8	21	0.8	16	1.1	37	0.5	30
86	drugs and pharmaceuticals	0.0	189	0.0	172	0.0	190	0.0	172
87	soaps and glycerine	0.3	111	0.1	119	0.2	138	0.0	171
88	perfumes, cosmetics & other toilet preparations	0.0	188	0.0	171	0.0	189	0.0	170
89	matches	0.0	187	0.0	170	0.0	188	0.0	169
90	lac including shellac	0.0	186	1.3	9	0.0	187	0.8	15
91	petroleum refineries	10.4	2	4.3	3	9.7	2	4.0	3
92	manufacture of miscellaneous products of petroleum & coal	2.2	13	0.8	15	1.9	17	0.7	20
93	fire bricks	0.1	162	0.0	169	0.4	87	0.1	119
94	refractories & furnace lining bricks—acidic, basic & neutral	0.7	56	0.2	71	0.6	58	0.2	70
95	tiles	0.1	161	0.0	168	0.2	137	0.1	118
96	glass hollowware	0.1	160	0.0	167	0.2	136	0.0	168
97	sheet and plate glass	1.1	35	0.4	36	1.1	36	0.4	41
98	glass wool & miscellaneous glassware	0.2	139	0.1	118	0.2	135	0.1	117
99	laboratory glassware	0.3	110	0.1	117	0.4	86	0.1	116
100	chinaware and pottery	0.2	138	0.0	166	0.3	109	0.1	115
101	sanitaryware and whiteware	0.4	85	0.1	116	0.4	85	0.1	114
102	insulators	0.4	84	0.1	115	0.5	69	0.2	69
103	manufacture of cement (hydraulic)	2.1	17	0.7	21	2.1	14	0.7	19
104	asbestos cement	0.5	73	0.1	114	1.4	23	0.4	40
105	hume pipes & other cement & concrete products (including reinforced products)	0.2	137	0.1	113	0.4	84	0.1	113
106	stone dressing and crushing	0.3	109	0.1	112	0.3	108	0.1	112
107	grinding wheels and abrasives	1.3	29	0.5	33	1.1	35	0.4	39
108	mica factories	0.0	185	0.0	165	0.0	186	0.0	167
109	manufacture of non-metallic mineral products n.e.c.—others	0.5	72	0.2	70	0.5	68	0.2	68
110	iron and steel (metal)	3.6	7	1.3	8	1.8	20	0.7	18
111	ferro-alloys	2.5	12	0.9	13	2.5	12	0.9	14
112	iron & steel castings and forgings	0.3	108	0.1	111	0.2	134	0.1	111
113	iron and steel structurals	0.3	107	0.1	110	0.4	83	0.1	110
114	iron and steel pipes	0.8	48	0.3	50	1.3	25	0.5	29
115	non-ferrous basic metal industries	2.1	16	0.8	14	6.1	4	2.3	6
116	metal containers and steel trunks	0.3	106	0.1	109	0.3	107	0.1	109
117	cutlery, locks etc.	0.1	159	0.0	164	0.1	161	0.0	166
118	bolts, nuts, nails, screws, springs, chains etc.	0.6	63	0.2	69	0.5	67	0.2	67
119	enamelling, japaning & lacquering, galvanising, plating and polishing metal products	0.2	136	0.0	163	0.1	160	0.0	165
120	type founding	0.2	135	0.0	162	0.2	133	0.0	164
121	welding	0.2	134	0.1	108	0.2	132	0.1	108
122	safes and vaults	0.0	184	0.0	161	0.0	185	0.0	163

1	2	3	4	5	6	7	8	9	10
123	razor blades	0.8	47	0.3	49	0.3	106	0.3	52
124	hurricane lanterns	0.1	158	0.0	160	0.1	159	0.0	162
125	hand tools and small tools	0.9	40	0.3	48	0.9	47	0.3	51
126	metal fittings for shoes and leather articles & wearing apparel	0.3	105	0.1	107	0.3	105	0.1	107
127	sanitary & plumbing fixtures & fittings of metals	0.2	133	0.0	159	0.1	158	0.0	161
128	weights & manufacture of metal products except machinery & transport equipment	0.3	104	0.1	106	0.3	104	0.1	106
129	boilers and steam generating plants	5.3	4	2.3	5	5.3	6	2.3	5
130	internal combustion engines	0.6	62	0.2	68	0.4	82	0.2	66
131	textiles machinery (such as spinning frames, carding machines, powerlooms, etc., including textiles)	0.4	83	0.1	105	0.4	81	0.1	105
132	jute machinery	0.5	71	0.2	67	0.5	66	0.2	65
133	sugar machinery	0.7	55	0.3	47	0.7	54	0.3	50
134	tea machinery	0.5	70	0.1	104	0.4	80	0.1	104
135	mining machinery	1.0	36	0.4	35	1.2	28	0.5	28
136	metallurgical machinery & cement machinery	0.8	46	0.3	46	0.8	49	0.3	49
137	chemical machinery	0.3	103	0.1	103	0.3	103	0.1	103
138	pharmaceutical machinery	0.3	102	0.1	102	0.3	102	0.1	102
139	paper machinery	1.3	28	0.5	32	1.3	24	0.5	27
140	construction machinery	0.4	82	0.2	66	0.3	101	0.1	101
141	oil mill machinery	0.3	101	0.1	101	0.2	131	0.1	100
142	rice, dal and flour mill machinery	0.0	183	0.0	158	0.1	157	0.0	160
143	size reduction equipment—crushes, ball mill etc.	0.2	132	0.1	100	0.2	130	0.1	99
144	conveying equipment : bucket elevators, skid hoists, cranes, derricks, etc.	0.4	81	0.2	65	0.6	57	0.2	64
145	mixers & reactors—kneading mills, turbomixers, etc. & centrifugal machines	0.4	80	0.1	99	0.4	79	0.1	98
146	power-driven pumps—reciprocating, centrifugal etc.	0.2	131	0.1	98	0.3	100	0.1	97
147	air & gas compressors & vacuum pumps (excluding electrical furnaces)	0.7	54	0.2	64	0.5	65	0.2	63
148	refrigeration plants for industrial use	0.2	130	0.1	97	0.2	129	0.1	96
149	fire fighting equipment and appliances including fire engines	0.1	157	0.0	157	0.1	156	0.0	159
150	ball, roller and tapered bearing and speed reduction units	1.4	25	0.5	31	1.5	21	0.5	26
151	machine tools	0.8	45	0.3	45	0.6	56	0.2	62
152	tractors, harvesters etc.	1.2	32	0.5	30	1.1	34	0.5	25
153	agricultural implements	0.2	129	0.0	156	0.2	128	0.0	158
154	earth moving machinery & forklift trucks etc.	0.6	61	0.2	63	0.5	64	0.2	61
155	typewriters and duplicators	0.7	53	0.2	62	0.7	53	0.2	60
156	calculating machines & other commercial, office & household equipments	0.3	100	0.1	96	0.3	99	0.2	59
157	air-conditioners and refrigerators	0.3	99	0.1	95	0.3	98	0.1	95
158	sewing and knitting machines	0.5	69	0.2	61	0.5	63	0.2	58
159	weighing machines	0.3	98	0.1	94	0.3	97	0.1	94
160	machinery except electrical machinery—others	0.2	128	0.1	93	0.2	127	0.0	157
161	equipment for generation, transmission & distribution of electricity including transformers	1.1	34	0.5	29	1.2	27	0.5	24
162	electrical motors	0.5	68	0.2	60	0.8	48	0.3	48

1	2	3	4	5	6	7	8	9	10
163	electrical fans	0.3	97	0.1	92	0.3	96	0.1	93
164	electrical lamps	0.6	60	0.2	59	0.5	62	0.2	57
165	manufacture of electrical furnaces, X-ray equipment, electrical machinery, apparatus, appliances & supplies—others	0.2	127	0.1	91	0.4	78	0.1	92
166	electrical cables and wires	1.2	31	0.5	28	0.9	46	0.4	38
167	household appliances such as electric irons, heaters etc.	0.2	126	0.1	90	0.2	126	0.1	91
168	storage batteries	0.9	39	0.3	44	0.9	45	0.3	47
169	dry cells	0.2	125	0.1	89	0.2	125	0.1	90
170	telephones	0.3	96	0.1	88	0.3	95	0.1	89
171	telegraph equipment and teleprinters	0.1	156	0.0	155	011	155	0.0	156
172	wireless communication apparatus & radio receivers including amplifying & public address equipment	0.4	79	0.2	58	0.4	77	0.1	88
173	ships and other vessels drawn by power	0.2	124	0.0	154	0.2	124	0.1	87
174	boat building	0.1	155	0.0	153	0.1	154	0.0	155
175	railway locomotives	0.3	95	0.1	87	0.2	123	0.1	86
176	railway rolling stock	0.1	154	0.0	152	0.1	153	0.0	154
177	tramway works	0.0	182	0.0	151	0.0	184	0.0	153
178	manufacture of motor vehicles	1.1	33	0.4	34	1.0	39	0.4	37
179	repair of motor vehicles	0.1	153	0.0	150	0.1	152	0.0	152
180	manufacture of motor cycles & bicycles & manufacrure of transport equipment n.e.c.	0.8	44	0.3	43	1.1	33	0.4	36
181	manufacture of aircraft	1.8	20	0.7	20	1.0	38	0.4	35
182	surgical instruments	0.1	152	0.0	149	0.1	151	0.0	151
183	water meters, steam meters and electricity meters	0.7	52	0.3	42	0.7	52	0.3	46
184	industrial instruments, indicating, recording & regulating devices for pressure, temperature, rate of flow, weights levels etc.	0.8	43	0.3	41	0.9	44	0.3	45
185	scientific instruments	0.2	123	0.1	86	0.2	122	0.1	85
186	mathematical surveying & drawing instruments	0.3	94	0.1	85	0.2	121	0.1	84
187	photographic printing paper & manufacture of photographic & optical goods—others	0.0	181	0.0	148	0.1	150	0.0	150
188	manufacture of watches and clocks	0.8	42	0.3	40	0.9	43	0.4	34
189	jewellery	0.1	151	0.0	147	0.1	149	0.0	149
190	mints	0.3	93	0.1	84	0.3	94	0.1	83
191	manufacture of musical instruments	0.1	150	0.0	146	0.1	148	0.0	148
192	pen and pencil making	0.2	122	0.1	83	0.2	120	0.1	82
193	fountain pen manufacturing	0.1	149	0.0	145	0.1	147	0.0	147
194	button making	0.9	38	0.3	39	0.9	42	0.3	44
195	manufacture of ice	1.8	19	0.6	23	1.8	19	0.6	22
196	plastic moulded goods	0.5	67	0.2	57	0.4	76	0.2	56
197	celluloid articles & manufacturing industries not elsewhere classified—others	0.4	78	0.1	82	0.2	119	0.1	81
198	brooms and brushes	0.1	148	0.0	144	0.1	146	0.0	146
199	games and sports goods	0.1	147	0.0	143	0.1	145	0.0	145
200	toy manufacturing	0.0	180	0.0	142	0.0	183	0.0	144
201	wrapping, packing, filling, etc. of articles	0.0	179	0.0	141	0.0	182	0.0	143
202	bones, ivory, horns, hoofs, claws and similar products (bone crushing)	0.1	146	0.0	140	0.0	181	0.0	142
203	slates and slate products	0.0	178	0.0	139	0.0	180	0.0	141

TABLE 17

Gross Profit and Depreciation per Worker and per Manhour in All Industries for Various States, 1963

Sl. No.	States	Gross Profit				Depreciation			
		per worker		per manhour		Per worker		Per manhour	
		value	rank	value	rank	value	rank	value	rank
1	2	3	4	5	6	7	8	9	10
1	Andhra Pradesh	5.7	5	2.6	2	0.8	5	0.4	2
2	Assam	5.1	9	2.1	9	0.8	6	0.3	3
3	Bihar	5.1	10	2.1	10	0.7	7	0.3	4
4	Gujrat	6.1	3	2.5	3	0.9	2	0.3	5
5	Jammu & Kashmir	3.3	18	1.6	18	0.3	18	0.1	18
6	Kerala	5.6	6	2.3	6	0.9	3	0.3	6
7	Madhya Pradesh	4.6	15	1.9	15	0.7	8	0.3	7
8	Madras	5.1	11	2.1	11	0.5	15	0.2	10
9	Maharashtra	7.1	1	2.9	1	0.9	4	0.3	8
10	Mysore	5.8	4	2.4	5	0.6	11	0.2	11
11	Orissa	6.2	2	2.5	4	1.3	1	0.5	1
12	Punjab	5.1	12	2.1	12	0.7	9	0.2	12
13	Rajasthan	4.4	16	1.8	17	0.6	12	0.2	13
14	Uttar Pradesh	4.8	13	2.0	13	0.6	13	0.2	14
15	West Bengal	5.5	7	2.3	7	0.6	14	0.2	15
16	Delhi	5.2	8	2.3	8	0.5	16	0.2	16
17	Goa	0.0	20	0.0	20	0.0	20	0.0	20
18	Himachal Pradesh	4.2	17	1.9	16	0.5	17	0.2	17
19	Pondicherry	4.7	14	2.0	14	0.7	10	0.3	9
20	Tripura	1.2	19	0.5	19	0.2	19	0.0	19

TABLE 18
Coefficients of Correlation of Ranks

Set of characteristics	All India		States	
	per worker	per manhour	per worker	per manhour
0	1	2	3	4
1. gross profit and value added	0.984	0.982	0.978	0.976
2. gross profit and productive capital	0.835	0.816	0.808	0.790
3. gross profit and wages and benefits	0.678	0.622	0.662	0.620
4. gross profit and depreciation	0.756	0.692	0.711	0.647
5. depreciation and value added	0.676	0.608	0.623	0.567
6. depreciation and productive capital	0.871	0.818	0.862	0.798
7. depreciation and wages and benefits	0.531	0.462	0.502	0.455
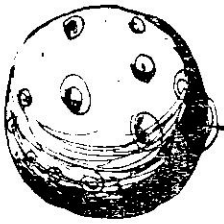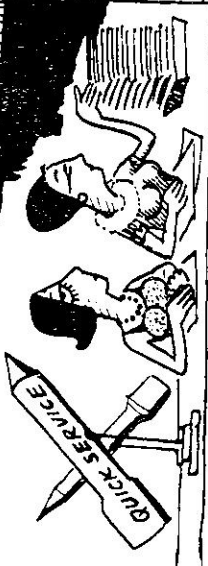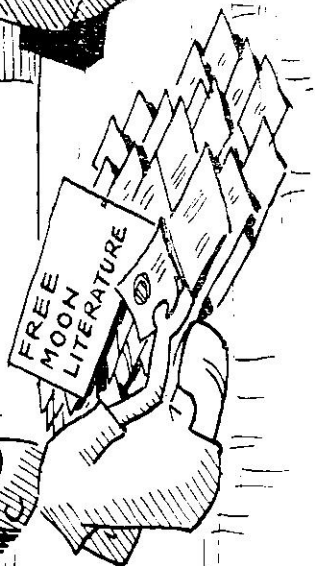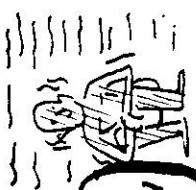
From Job Differentials To Wage Differentials

RP Khandelia*

Job Evaluation is an instrument of wage-administration. It seeks to price each job for what's worth and create measured job-differentials, as a foundation for a sound wage structure, to help create proper and fair wage-differentials, in turn. However, if we fail to attain this objective, for whatever reasons, we would have also failed in our venture to effectively implement and install the basic facets of job-evaluation and to integrate jobs as well as human beings into a joint organisational endeavour of sound wage-administration.

While job-evaluation is an important segment of wage theory and practice in that it establishes a wage-payment system with compensation proportionate to job-difficulty, it does not provide for variabilities in individual performance levels. Thus, the symmetry and cohesiveness of the entire wage-structure are distorted if other vitalising factors like 'performance-rating' are not appraised with the same exactness and equity of approach.

THE OBJECTIVE OF A GOOD INCENTIVE SYSTEM is to stimulate individuals to exceed the accepted norms of performance and to provide extra compensation for extra performance in strict proportion to contribution. A general wage-payment formula already in vogue (given below) gives due consideration to all its constituent factors, viz., time, effort, ability, job-differentials and minimum wage levels.

$$E = a\sqrt{b \times c}(m+n+p)$$
or $\quad E \propto b \times c$

where E=earnings, a=time worked, b=extra effort expended,

c=extra ability applied, m=minimum wage level

n=job-differential for difficulty,

p=job-differential for tenure and seniority.

The product $b \times c$ injects the element of incentive into the system. Performance appraisal —a measure of labour-productivity—does not merely scale labour efficiency for increased effort or increased pace of work: it also evaluates all operator-controlled actions, leading to reduced labour input per unit of output: more skilled operations and increased efficiency and effort by operatives of the same skill.

Sound logic dictates that all the factors (as picked up for job evaluation) that make up for the monetary worth of the job should be rated in the light of added operative efforts and suitable multipliers established to assess the weighted contribution of each factor for every unit rise in operative's productivity, to calculate extra compensation that would be justified. Quantification of supposedly non-dimensional factors like manual skill,† mental skill and mental and/or visual fatigue etc., of course, requires judgment.

In general practice, the bonus or incentive earning of operatives is calculated by the formula:

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*Hindustan Motors Ltd., Hooghly, W. Bengal

†How is manual skill non-dimensional?—**Editor**

Incentive earnings=Job Rate   × %age increase
in labour productivity above
the established norm.

The author has made an attempt to show that the monetary worth of extra performance (efforts) put in by an operative working under incentive is only a fraction of what is calculated by the above formula. The rise in performance level is not in linear proportion to all the factors comprising the job for its monetary worth (i.e. job-rate), and in fact, some factors like education, experience and mental skill remain unaffected by and do not contribute towards the increased performance index of the worker. The resultant multiplier (of all factors) shall always be less than unity. Thus, the real worth of the extra performance shown by an operative can be given as

Incentive Earnings=(Job rate × Resultant Multi-
plier) × %age   increase in
labour productivity above
the norm.

or, Incentive Earnings=Incentive Rate × %age
increase   in   performance
above standard.

Thus, the incentive rate should only be a part of the job rate and quite different from it.

A correlation between the two concepts of job rate and incentive rate has been attempted for each distinct class of jobs. Different incentive rates corresponding to different job rates are established and their quotients calculated to show that they do not bear the same ratio to their respective job rates. Wage inequalities, therefore, arise among job-classes if incentive payments are made in proportion to job rates (and not incentive rates) as practiced today. Besides, this concept of incentive rate is yet another reflection of our failure to recognise so far that what we call 100 per cent incentive is in effect something higher, the job rate being greater than incentive rate.

Let the jobs be evaluated for the following main and sub-factors:

SKILL

   i.   Education

ii.   Experience
iii.   Mental Skill
iv.   Manual Skill

EFFORT

   i.   Physical
  ii.   Mental

RESPONSIBILITY

   i.   For Equipment/Process
  ii.   Product/Material
iii.   Work of others
iv.   Safety of others

WORKING CONDITIONS

    Working Conditions

HAZARDS

   i.   Accident
  ii.   Occupational

Education

This factor appraises the requirements for the use of shop mathematics, basic trade knowledge, ability to understand drawings, use measuring devices, tools etc. Acquisition of education additional to that demanded by the job does not lead to increased output levels or improved performance. Also improved performance on the same job over and over again does not educate an operative any further. Reading a micrometer twice instead of once in a given time, or making faster calculations might result in increased manual and mental proficiency but definitely it does not educate or train an operator making calculations of whole numbers only, for a job or a situation which may involve conversion of decimals to fractions and *vice versa*. Alternatively, a knowledge of decimals and fractions does not help him to make calculations of whole numbers more rapidly. Education, therefore, helps to accomplish the job or prepares a man to meet and face a situation inherent in or with the job but the rate of application of educational know-how, whether slow or fast, is dependent upon other manual or mental faculties. This factor, therefore, is not conducive to increased operative performance levels and therefore no additional reward

is warranted as there has been no added contribution.

Experience

This factor appraises the length of time required by an individual usually or typically to attain full manual and mental proficiency on similar or related work within or outside the organisation, with the specified education or trade knowledge. Any additional and varied experience other than required by the job components will not help to improve labour efficiency on the particular job especially when jobs are repetitive, for which operational details are set and standard procedures maintained. Similarly, working on more parts (and not a variety of parts) in the given time-period will lead to higher manual and mental skill, and not increased or diversified experience: just as ten years experience may, in fact, be equivalent to only two years experience of continuous progress repeated five times. That is, an operator doing one type of work is not trained to do jobs requiring more varied experience. This factor also, therefore, is not to be rated afresh.

Mental Skill

This factor considers the requirement of ability to think out and solve operational problems, or to plan a course of action, or to anticipate difficulties. In non-repetitive jobs where frequent variations are met, mental skill considerably affects operative performance. But in case of repetitive jobs (generally encountered in mass production and capital intensive industries) standard operation procedures are made available and the set-up and sequence established. Only routine and planned actions as the result of a habit cycle are involved, leaving little scope for the exercise of ingenuity or mental skill by an operator that may affect his performance, resulting in increased productivity. This factor also does not help to exceed the standard norm of performance for repetitive jobs where direct incentive payments are generally in use.

All the other factors directly affect performance level or operator in person and should therefore be considered for the monetary value of the incentive rate.

Responsibility and hazards are involved in direct proportion to the number of parts handled whereas 'Working Conditions' can be grouped under two heads: (a) *Fixed* and (b) *Variable*. Fixed working conditions are those to which an operator is exposed throughout the shift whether he works or not, works faster or slower by virtue of his being present at the work centre, viz., ventilation, humidity, indoor/outdoor place of work, etc., and is, therefore, not affected any further by increased pace of work. This part of the working conditions does not, therefore, make up for the incentive rate.

An operator will be exposed to the variable part of the working conditions only when he starts to work on the job, Naturally, by exceeding the standard production, an operator works on more number of parts and is thus subjected to more of such conditions. And the monetary worth of this part i.e. variable working conditions should, therefore, form a part of the incentive rate.

Table 1, printed here, helps to show how wage-inequalities result amongst distinct and different job classes. Only two job classes of repetitive operations have been considered and the break-up of their job rates against each evaluating factor shown as derived after rating their corresponding job characteristics that make-up for the complete job description. Incentive rates are then deduced after studying the effect of each constituent factor upon operative or job performance and operator in person.

Jobs of one particular class naturally have similar job characteristics and demand similar or same skill, effort, responsibility, working conditions and hazards, with the result that the fraction K (ratio of incentive rate to job rate) tends to settle down within a very narrow range at a more or less fixed value. Thus, well defined incentive rates corresponding to each distinct job rate (job classification) can be established by obtaining different K values for different job classes.

Value of K is a function of the proportion that the sum weightage of factors (categorised 'NO')—education, experience, mental skill and

Table 1

PERFORMANCE ANALYSIS WHEN THE ESTABLISHED NORM IS EXCEEDED

Factors that make up for the monetary worth of the job	Job Class A			Job Class B		
	Split-up of job rate in Paise	Factors affecting performance or operator in person beyond standard performance 'Yes' or 'No'	Incentive rate build-up in Paise	Split-up of job rate in Paise	Factors affecting performance or operator in person beyond standard performance 'Yes' or 'No'	Incentive rate build-up in Paise
SKILL						
1. Education	70	No	—	20	No	—
2. Experience	110	No	—	50	No	—
3. Mental Skill	30	No	—	10	No	—
4. Manual Skill	40	Yes	40	25	Yes	25
EFFORT						
5. Physical	50	Yes	50	30	Yes	30
6. Mental and/or Visual	25	Yes	25	15	Yes	15
RESPONSIBILITY						
7. Equipment/Process	25	Yes	25	10	Yes	10
8. Product or Material	25	Yes	25	10	Yes	10
9. Work of others	25	Yes	25	10	Yes	10
10. Safety of others	25	Yes	25	10	Yes	10
WORKING CONDITIONS						
11. (a) Fixed	30	No	—	15	No	—
(b) Variable	20	Yes	20	20	Yes	20
HAZARDS						
12. Accident	15	Yes	15	15	Yes	15
13. Occupational	10	Yes	10	10	Yes	10
	Rs. 500		Rs. 2.60	Rs. 2.50		Rs. 1.55

JOB CLASS A—Ratio of Incentive Rate to Job rate i.e. $K1 = \dfrac{2.6}{5} = 0.52$

JOB CLASS B—Ratio of Incentive Rate to Job rate i.e. $K2 = \dfrac{1.55}{2.50} = 0.62$

fixed working conditions—bear to the total point values of all factors which in turn, is a function of job characteristics or job-classes. Expressed mathematically,

$$K = f\left[\frac{\text{Value}}{\Sigma} \text{ Factors (1, 2, 3, and 11a)}\right]$$

and $\dfrac{\text{Value}}{\Sigma}$ Factors (1, 2, 3, and 11a)

$= f$ [Job-characteristics]

Different jobs will have different job-characteristics and, therefore, different weightage of factors marked 'NO' in the Appendix.

However, for plants, with little variation in job-characteristics, viz., one class of jobs only, there will be only one value of K and

True or actual incentive $=$ Incentive paid (as today) $\times \frac{1}{K}$

Incentive payments should, therefore, be based on incentive rates and not job rates. Wage-inequalities will result if payments are based on job rates because different incentive rates bear different ratios to their respective job rates.

(See Appendix I on p. 564)
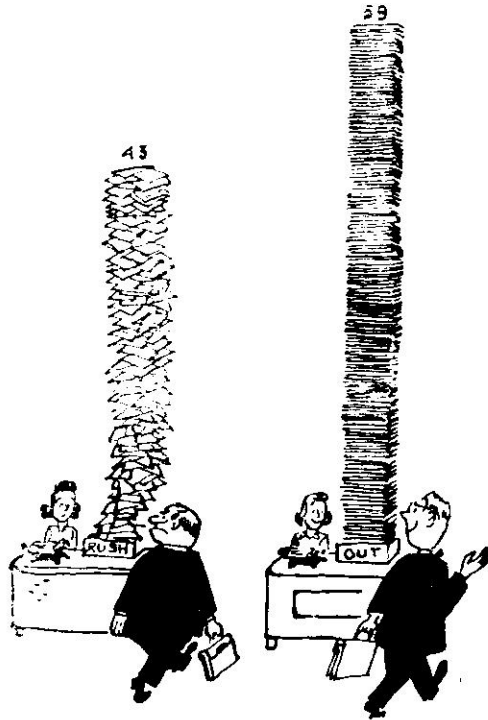
APPENDIX I

This Appendix seeks to demonstrate the practical use and application of the theory evolved in the above article.

A wage-survey throughout engineering industries in India would reveal that the job or base rates paid, that is, fall back wages are rather very poor and do not compare even with the level of need-based wages in many cases, although the total pay-packet favourably meets operative needs. This is only one aspect of the situation from the workers' point of view.

From the management's point of view, our industries are suffering from yet another disease being the higher false levels of productivity. It will generally be witnessed that the true productivity index is much lower than that measured for incentive payment purposes. The obvious reasons are: loose standards, non-standard and poor machine settings resulting in low equipment utilization, lack of knowledge of operational details and machinability, etc., etc.

However, a corrective action can be taken by using the concept of incentive rate as evolved above, which will result in higher fall back wage, i.e., increased job or base rate to the operatives and at the same time help management to establish correct productivity indices throughout the plant and also meet present earning levels of operatives so that no dissatisfaction arises as a result of the changed concept. To illustrate:

Let the present job rate in a work centre or for a class of jobs be Rs 2/- and the productivity index as measured today be 100%. If the incentive payment formula be:

Incentive earnings $= f(n-50) \times$ Job or Base Rate, where value of $f=2$, thus ensuring 100% incentive at 100% n, then

Incentive earnings $= 2(1-0.50) \times 2 =$ Rs. 2. and Basic + Incentive earnings $=$ Rs. $(2+2)=$ Rs.4.

Now, if the correct productivity index of the above work centre under standard conditions be

70% and the value of factor 'K', i.e. ratio of incentive rate to job rate be 0.75 depending on job characteristics (as discussed earlier in the article), we know:

Job rate $= \dfrac{1}{K} \times$ incentive rate, and incentive earnings under correct Production Index would be :

Incentive earnings $= 2(0.7-0.5) \times \dfrac{1}{K} \times$ incentive Rate

or Incentive earnings $= \dfrac{0.4}{0.75} \times$ Incentive Rate

$= 0.53 \times$ Incentive Rate.

Meeting present earning levels of operatives, Job Rate + Incentive Earnings $=$ Rs. 4. or in other words,

$\dfrac{1}{0.75} \times$ Incentive Rate $+ 0.53 \times$ Incentive Rate $=$ Rs. 4.

Whence, Incentive Rate $=$ Rs. 2.15 and job rate $= \dfrac{1}{K} \times$ Incentive Rate $= \dfrac{2.15}{0.75}$

$=$ Rs. 2.86

This will result into a Job Rate of Rs. 2.86 and an incentive rate of Rs. 2.15 for the operatives at the true productivity index against a job rate of Rs. 2 paid before. Analysing further,

Incentive earnings $=$ Rs. $2(0.7-0.5) \times 2.86$ $=$ Rs. 1.14 against Rs. 2 earned before.

The two cases are presented below, side by side

	CASE I	CASE II
Job or Base Rate	Rs. 2.0	Rs. 2.86
Incentive Rate	Rs. 2.0	Rs. 2.15
Productivity Index	100% (false)	70% (true)
Incentive Earnings	Rs. 2.0	Rs. 1.14
Basic + Incentive Earnings	Rs. 4.0	Rs. 4.0

It will be observed that a decrease in incentive potential is compensated by a corresponding increase in job or base rate, i.e. fall-back wage.

Moreover, in highly capital-intensive and automated industries where the plant size, proportions and design are the major factors contributing to output, the effect of individual operative performance being small, most operatives whose work is measured, fall within a very narrow range of productivity index. In such cases, therefore, a high job rate resulting in higher fall back wage and small incentive payment are justified.

Besides, if the incentive potential is still to be maintained or increased, then the incentive scheme can be geared as follows:

(a) Incentive Earnings $= 2(n-50) \times$ Job Rate up to present P.I. level of 70% and,

(b) Incentive Earnings $= f(n-50) \times$ Job Rate for P.I. above 70% where $f > 2$.

If the managements in our industries today take a quick decision to this effect, they will not be caught unawares when the Wage Board recommends higher fall-back wages and the management is forced to revise the wage-structure without being able to correct the productivity levels as measured today.

The Punjab Government has already taken a lead to revise minimum wages of workers in 12 industries and link them with the cost of living index. Minimum wages in two more industries have also been revised but not linked with the cost of living index.
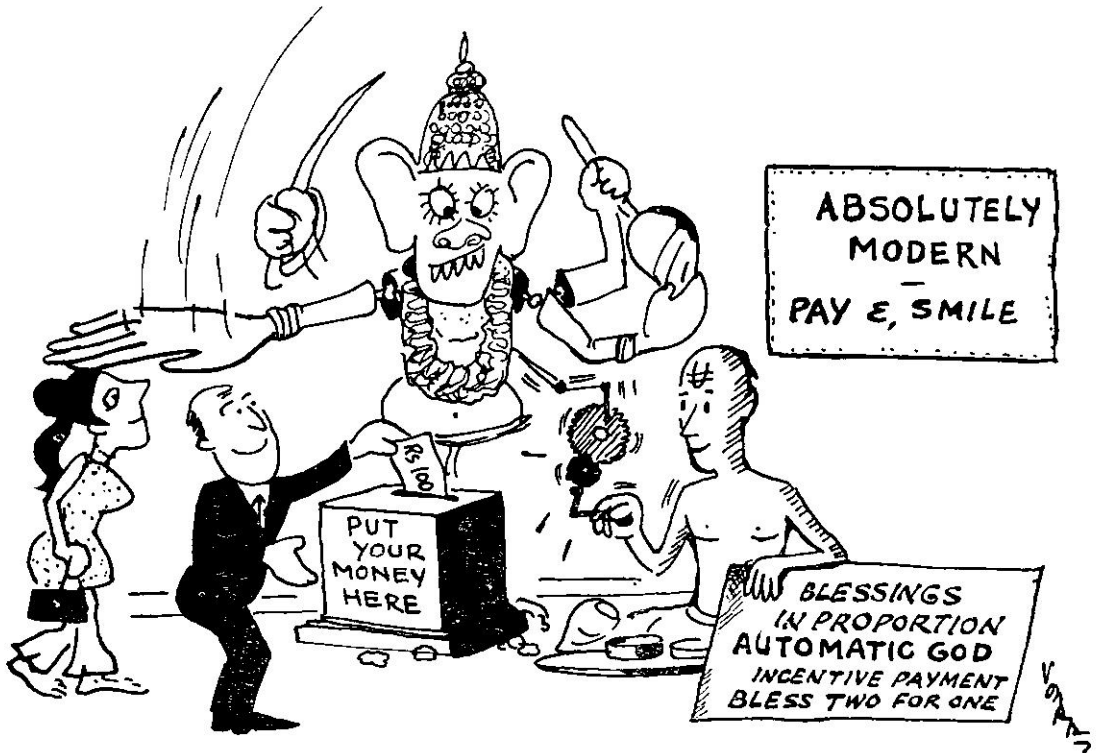
APPENDIX II

The author claims to have attempted a general job evaluation for engineering industries; and in this context, he has arrived at certain values of job rates, incentive rates and factor 'f' for each grade.

This scheme for incentive payment works out as follows: Incentive earnings $= f (n—50) \times$ Job or Base wage, which ensures incentive earnings on exceeding 50% standard Productivity Index as established by the work standards department.

Looking back to the formula,

Incentive Earnings $= f \times$ increase in n above 50% (or as envisaged in the Incentive formula) $\times$ Job or base wage.

Job or Base wage is a fixed coefficient for the class of job on which an operative has been employed, and increase in n is a factor directly related to an operative's performance or labour index. Thus, Incentive Earnings $\propto f$ when the other two ingredients of the formula are known, i.e., for a given job at the given n level.

TABLE 2

S.No.	Job Grade	Range (Points)	Average Job Rate Rs.	Average Incentive Rate Rs.	VALUE FACTOR 'f' Productive Jobs	VALUE FACTOR 'f' Non-Productive Jobs
1	A	301—350	3.25	2.20	1.35	—
2	B	351—400	3.75	2.25	1.20	—
3	C	401—450	4.25	2.75	1.30	1.47
4	D	451—500	4.75	3.50	1.50	1.55
5	E	501—550	5.25	4.20	1.60	1.68
6	F	551—600	5.75	4.75	1.65	1.70
7	G	601—650	6.25	5.30	1.70	1.75
8	H	651—700	6.75	5.75	1.70	1.72
9	I	701—750	7.25	5.00	1.38	1.60

A rationalised value of factor 'f' on the basis of the theory, detailed for each class of jobs, is given in Table 2. Two values of factor 'f' for the same class of jobs for productive and non-productive shops illustrates the incentive differential to be maintained for reasons already discussed in the article ● ● ●

And When You Are The Boss

KS Bhatnagar*

SO YOU ARE THE BOSS! YOU WANTED TO BE ONE. *When you were not† you had difficulties with the boss, with colleagues and subordinates. You thought that the panacea lay in being the boss; for then you need only to order* and others would obey; erstwhile colleagues would vie with each other to please you, and subordinates would be all respect...

You are now the head of an office or the manager of a factory employing 10 men or even ten thousand. You have financial and administrative powers. You do not have your immediate boss on the spot, to whom you can pass on your problems. You have to assume responsibility and take decisions consistent with your authority and face the consequences of what you do.

You were happy for a while. When you came to grips with the problems, you found that all was not well with being the boss. Problems had placed you on the horns of a dilemma. You could not pass them on to your distant head office. Those below were passing theirs on to you.

You find that staff is not happy because someone below is not displaying the qualities of a supervisor. There is discontent among the workers. The union has already threatened to strike. Some other group has planned a demonstration in front of your house. *You have lost your peace. Even your near ones are worried* and tell you that they had not bargained for all this.

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*Assistant Director, Directorate General of Posts and Telegraphs, New Delhi.

†This is a sequel to the author's article on 'When You are Not the Boss', published in this Journal, Vol. IX. No. 2, Monsoon 1968.

But you need not have this feeling. You are not the only one with these problems. Others too are facing them. You also can brave them.

Your most important role is that of a leader. You have to deliver the goods to the best of your ability, and that you can develop. The capacity of leadership has been defined in various ways:

"A leader is a man who has the ability to get other people do what they do not want to do, and like it". Another one puts it as "the capacity and the will to rally men and women to a common purpose, and the character which inspires confidence." Eisenhower, of the last War fame says: "Any man who does his work well, who is justifiably self-confident and not unduly disturbed by the jeers of cynics and shirkers, any man who stays true to decent motives and is *considerate of others is in essence a leader.*"

In essence, you have to deal with man. No amount of equipment, whatever the quality, can be of any help unless the man behind them is loyal and devoted to you. It is the man that counts and not the machines. The raw material which you have to deal with is man. Let there be no mistake about it. *Those who think their raw material to be iron, cotton or rubber have to pay a very heavy price.* "If the approach to the human factor is cold and impersonal, then you achieve nothing. But if you can gain the confidence and trust of your men and they feel their best interests are safe in your hands, then you have in your possession a priceless asset and the greatest achievement becomes possible."

Being the boss, you are in a glass house. Every action of yours, both official and private,

is watched.   Outwardly you may appear to be free to do whatever you like; but actually restrictions are many. *You have to have respect for rules and procedures, or else none will have it.* Being the head, you set the pace for what happens in your organisation.

As the boss, you have to take decisions. These have to be quick. "Caution is a desirable quality, prudence is virtue, but to be obsessed with either is clearly a case of carrying matters too far." Moments of crisis will come. Orders have not only to be issued, but you have to ensure that they are carried out in the spirit you had intended. The decisions are both pleasant and unpleasant and no one likes to take orders. But there is no escape. You have, therefore, to have the ability to persuade. People should be persuaded rather than ordered.

It may be that a particular decision has let you down. It does not matter, "You must be able to stand strong under reverses, and rise again from defeat and battle, to learn from mistakes and push on."

Though the workers may rally round you, you have to win respect of the subordinates—rather you have to deserve it. This comes either from within or from without. It is the former that wins you loyalty and respect. This can be had by being polite, sympathetic, courteous and understanding. Psychological conditions are to be created which induce a worker to be willing and give his best. *Confidence has to be created, not by words but by deeds.* You have to help them with all that is in your power, and to be sympathetic about that which is beyond.

Both physical and mental working conditions are to be provided, which help the worker to be at his best.   Both these are complementary to each other. Excessive stress on one alone leads to imbalance. Physical working conditions comprise cleanliness, adequate ventilation, a good colour scheme, silence, adequate working space, good house-keeping, arrangement for fire-fighting, for prevention of accidents etc. Payments and settlement of personnel claims in time, sympathetic hearing, courteous and humane treat-

ment constitute the latter. No amount of your efforts can improve the former and bring the staff round unless proper climate and environment are created by attending to the latter. "A cheerful, enthusiastic and willing operative, with an affectionate regard for the establishment in which he is working, is a much greater asset than a fabulous automatic packing machine." In the long run, in terms of increased production and services, such an atmosphere pays a million times more! It is necessary, therefore, to have a cell of work study.[1] This takes care of the requirements and the working problems of the workers. It constantly devises methods which help in reducing the avoidable fatigue and improve the working.

Craving for appreciation, desire for fame, spirit of competition, etc., motivate a man to do more and more. You have, therefore, to create conditions that provide this motivation in a measure. You have, to be broad-minded and this can best be put to test by the way you look after your subordinates. *"To accept publicly the responsibility for the mistakes of the subordinates and to give them credit for their triumphs"* is a rare virtue, but the one who has it has the greatest asset with him.

Subordinates are to be trusted, for trust begets trust. Very few will fail you if you have confidence in them. *For the sake of less than 5% who may perhaps fail you, why create an atmosphere of suspicion all round,* which in its wake creates bottlenecks? Simultaneously you should try to know your men, their qualities, capacities and capabilities. This enables you to put the right man at the right place and at the right time. *A few should be thoroughly watched,* studied and tried. Those who stand the test

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[1]While we ourselves advocate the setting up of cells of work study and we think that work study is at the heart of the logic of Productivity, we do not know how it fits into the argument here, for creating a cheerful atmosphere for the workers is one thing and setting up a cell of work study is something quite different; and the two may not go together psychologically. Instances are not wanting of workers' resistance to work study; and unless preparatory steps are taken to ensure workers' appreciative acceptance of work study, it may not work out all right.—**Editor**

should be given a free hand within the framework of your plans and policies. This will relieve you of much of your responsibility and infructuous work. In dealing with subordinates, justice and keen sense of fairness are essential as also a full measure of human consideration.

You will be surrounded by advisers. They will be experts in their line. Some will know the limit and would stop when decision is otherwise, others will not. They would be vehement, little realising you may have other considerations. You need to be polite but firm with such people and not let them feel offended. It is perhaps due to inexperience and over-enthusiasm that the person concerned has crossed the limit.

Patience is a *must*. When you were not the boss, your impatience affected only the persons directly under you. The whole did not suffer. *Now one wrong action, one indiscreet word,* one hasty act may plunge the whole organisation in trouble. The public will be impatient with you and so will be the staff; but *you cannot afford to be impatient, for that is the sure way of losing the game.* Occasions will arise when it would be necessary to pull up the staff in the second and the third line. *Do dress them down, but not in presence of their subordinates.* This can only demoralise them.

The habit of going round the office and the factory pays good dividends. This need not be a fault-finding mission. You know your men at work. You know their problems. They can pose them to you, regarding you as one of their own. They can have the satisfaction of having solutions on the spot. This cuts red tape and creates a healthy atmosphere.

You cannot attend to all the functions. You have only two hands. They can work for three or four but not more. You have, therefore, to delegate, decentralise and supervise. *Once confidence has been created and the organisation geared up, the momentum will keep it going.*

Both you and your organisation work towards a certain end. Each has his assignment. Most of the difficulties arise due to misunderstanding which you can nip in the bud. *No false sense of prestige need keep you away from your subordinates.*

You need not be dogmatic about your views. Changes are coming pretty fast. What was modern yesterday is normal today and will be obsolete tomorrow. Hence the need to adjust to changing circumstances and conditions.

Lucky is the boss, who has succeeded in having able deputies and a band of loyal workers round him and earned the confidence and respect of the workers, endearing himself to them! ● ● ●

⮞⬥⬤⬥⬤⬥⮜

Is a Picture Worth a Thousand Words?

"... The British Post Office expects to have picture-telephones available sometime around 1990. The American Telephone and Telegraph Company has some on commercial trial now and will be offering them in limited public service in the early 1970s... Sweden and Japan have their trial models and the Siemens Company of Munich show off to visitors an elegant red and black picture-phone..."

—*Economist*, Aug., 9, 1969, p. XV

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"... The privilege of talking and even publishing nonsense is necessary in a Free State..."

—Malcolm Muggeridge

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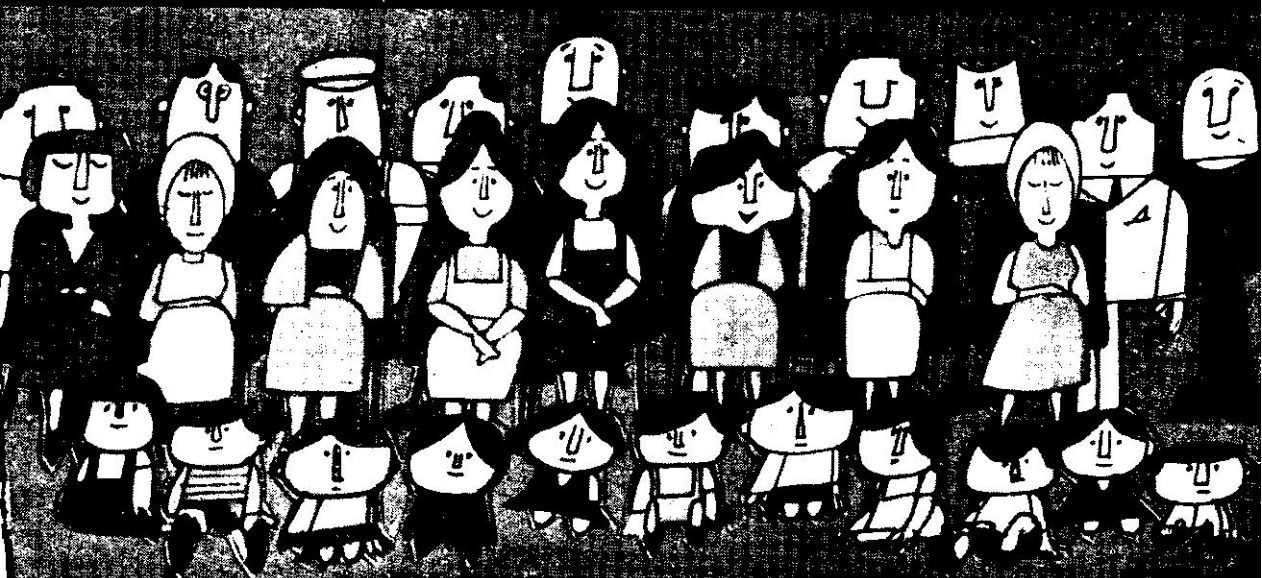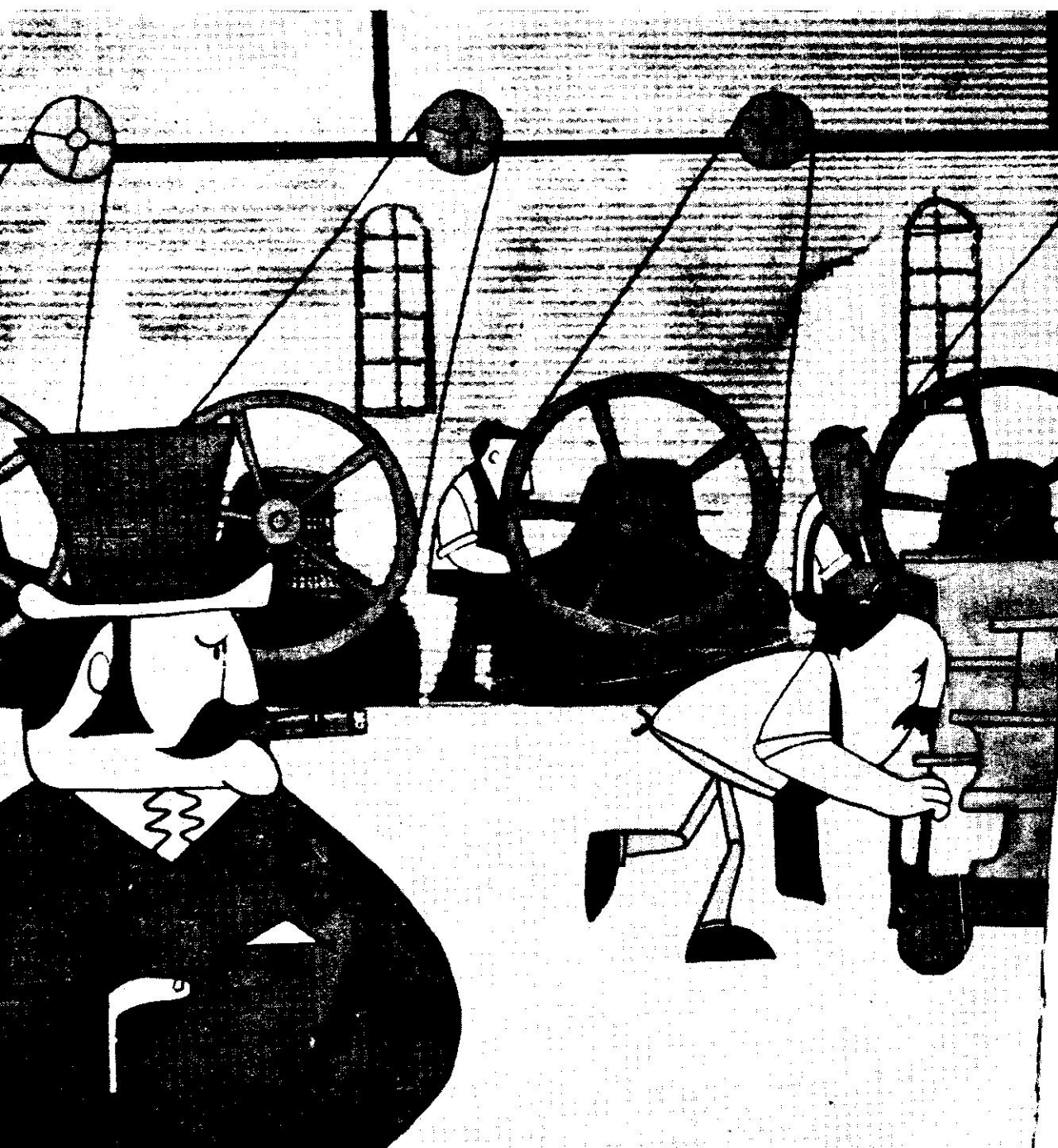
VEMENT IN THE UNITED STATES
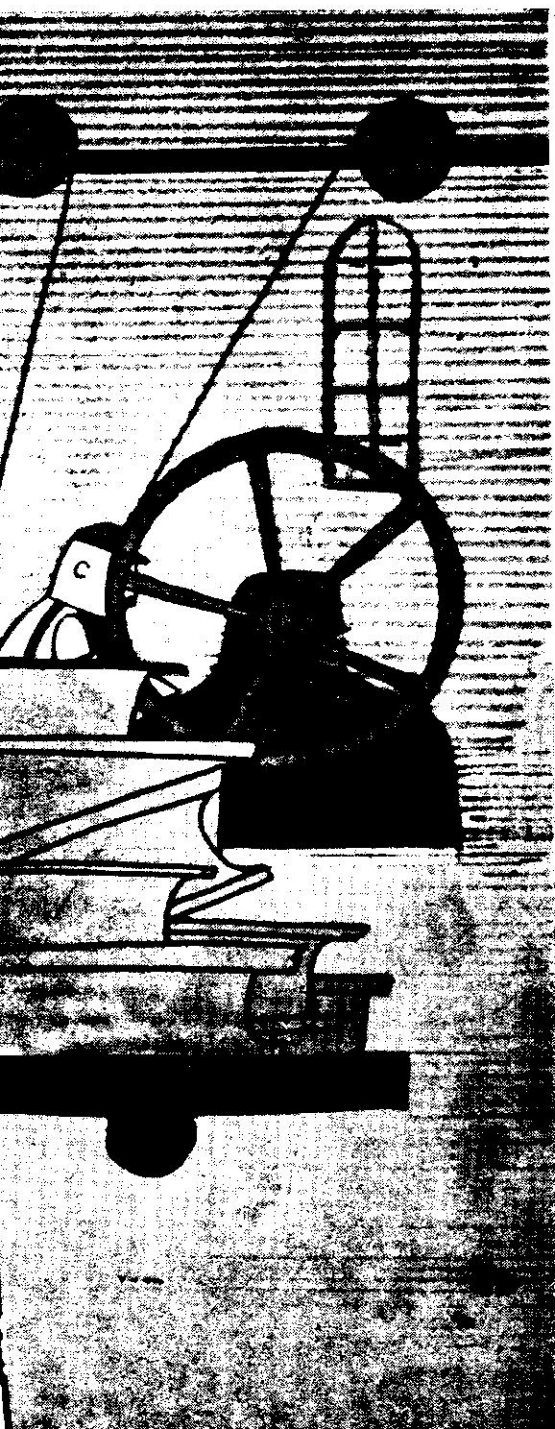
We print here, by the courtesy of the Editor of *American Labour* (New Delhi) a pictorial story* of the progress of the American Labour Movement, which through its cooperation with progressive forces in the United States, has pushed up the economy of that country from Depression to a full-employment, fair-wage level.

Here is shown the condition of American Labour in the early days of the colonial settlements, with indentured servants driving the wheels of industry.

* Originally printed in the November 1969 issue of *American Labour*, an organ of the United States Information Service in New Delhi.

A caricature of the heartless foreman and a worke[r] groaning under a superhuman load, depicting the earl[y] days of labour exploitation.
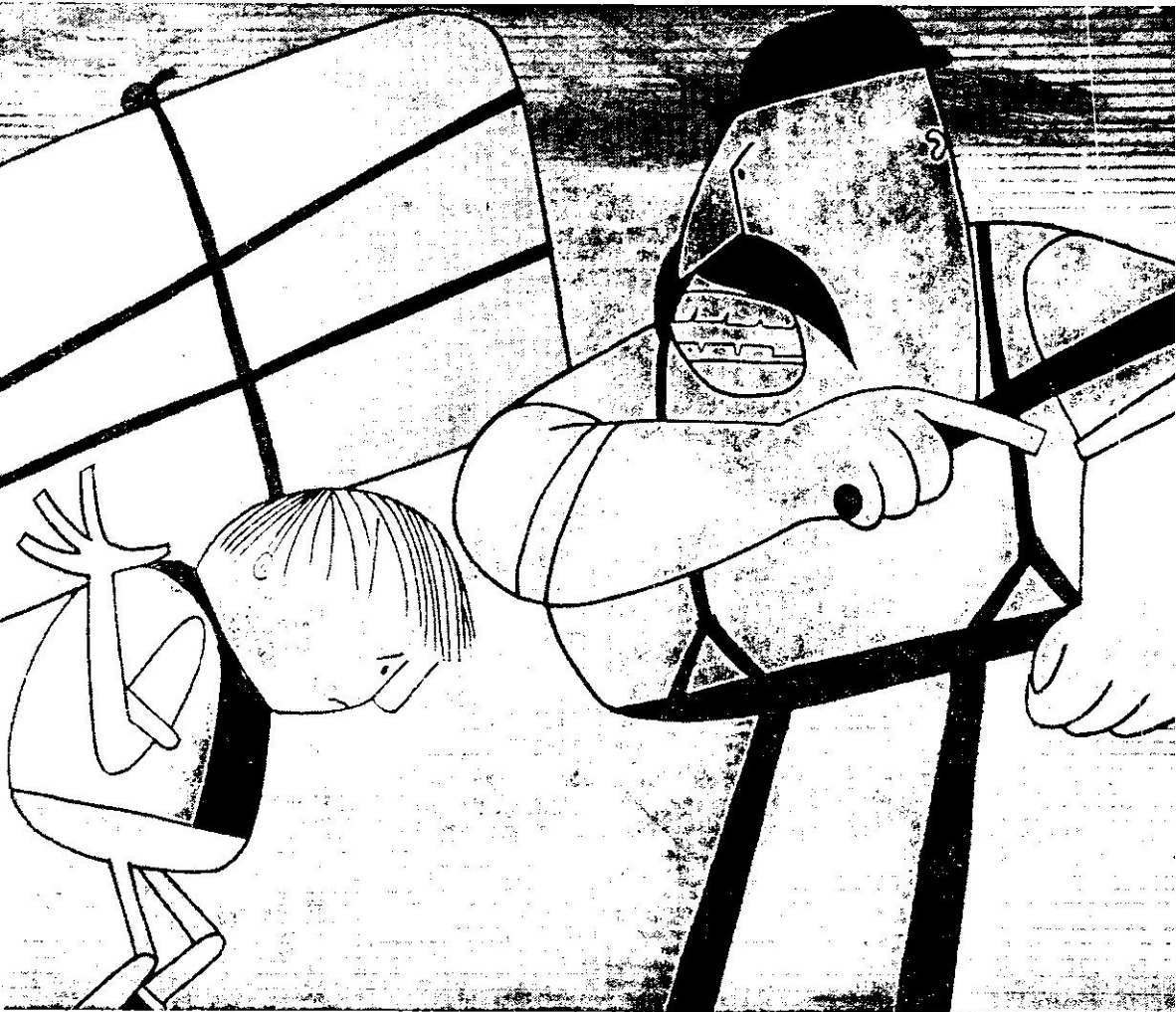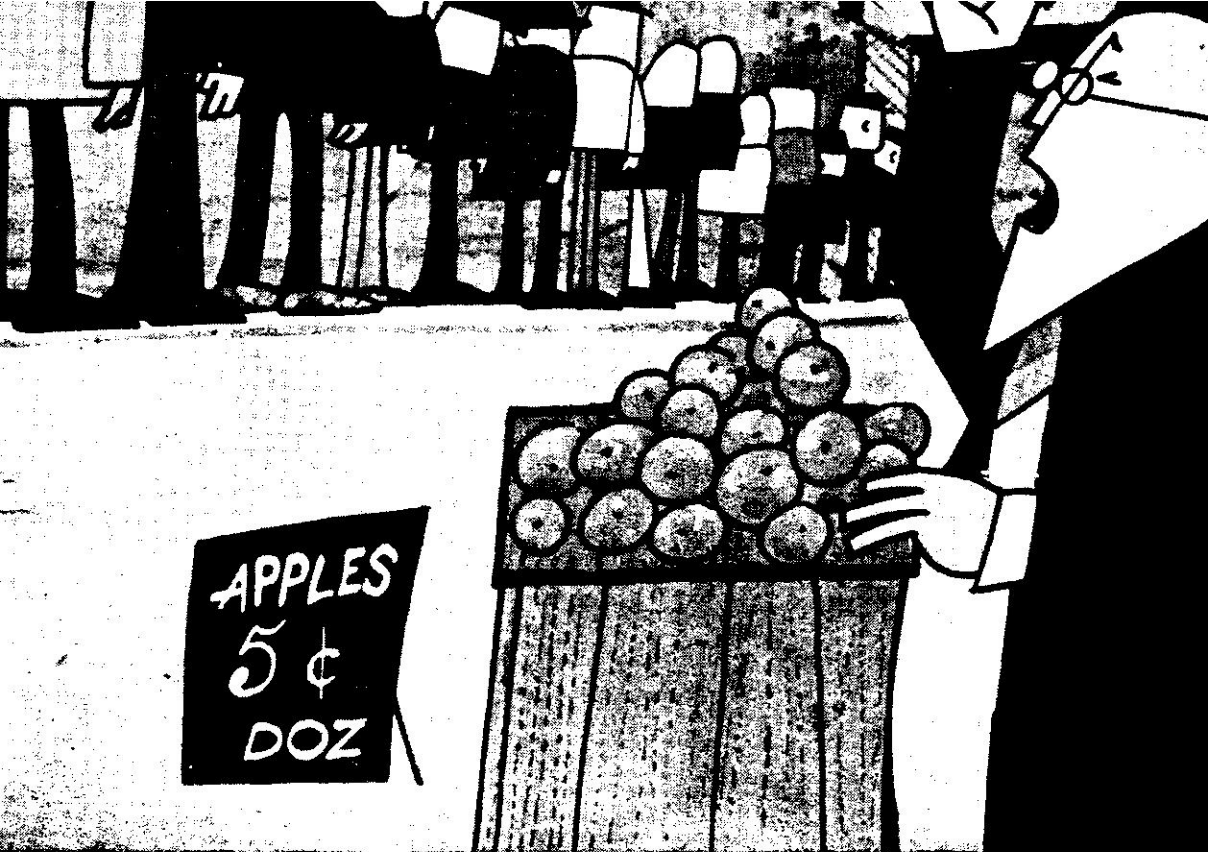
Many persons, thrown out of jobs by the Depression, tried—and failed, to make a living by selling apples on street-corners.
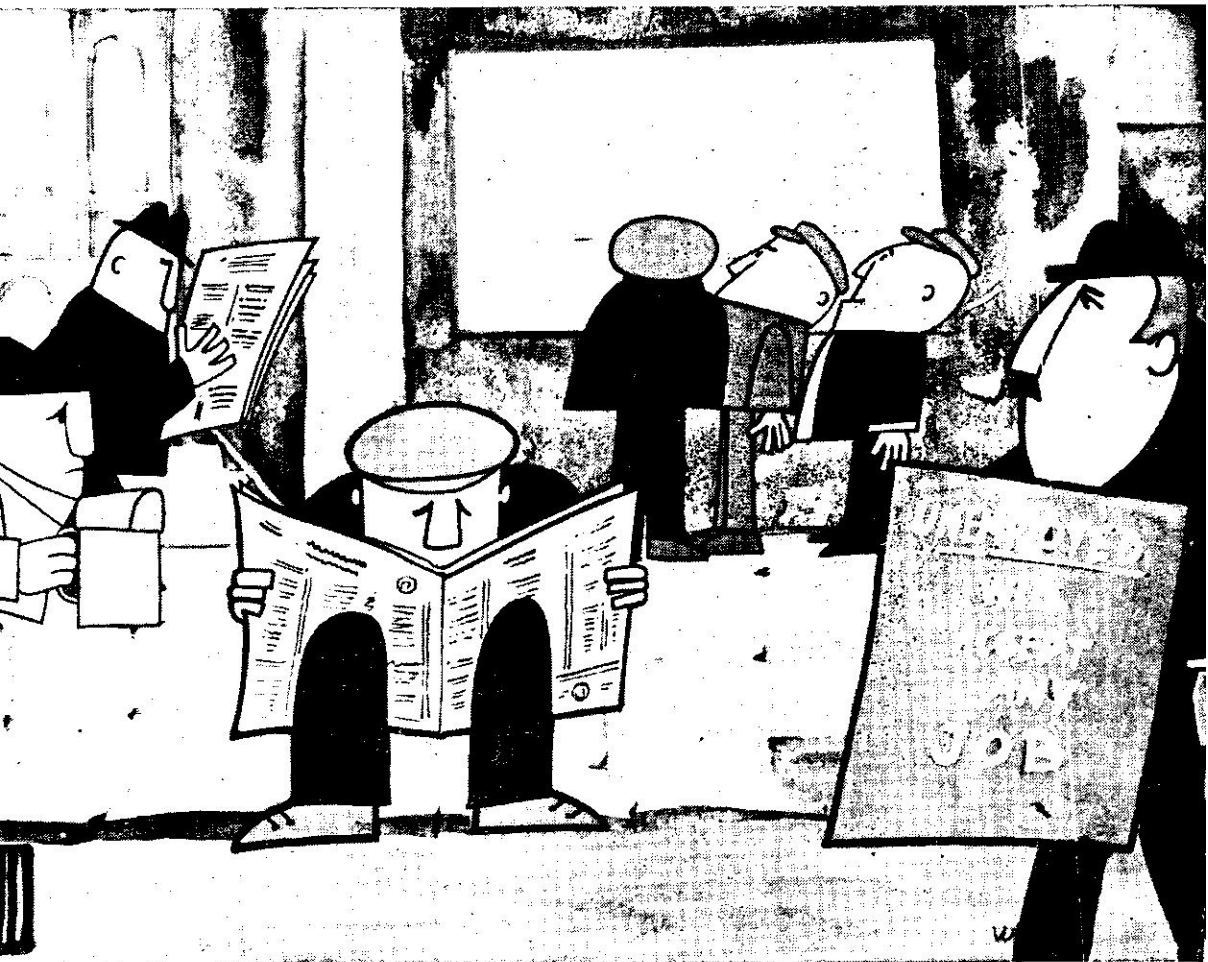
As the Great Depression deepened, and industries were unable to market their goods, un-employment mounted, and workers were thrown on the streets, not realising what had happened, nd not knowing what to do with themselves, looking out in vain for jobs that did not exist.

On this pathetic scene, children going to sleep without food, and men and women living on thin diets, with mortgages closing round them, and no employment to be had even for the begging, the Great President Franklin Delano Roosevelt arrived on the scene as a saviour of the American people. He launched what is called the New Deal: a series of measures by which he pumped heart into the depressed people of the United States, pumped money into the economy, and organised a whole series of measures and institutions to put people to work for themselves and for the good of the country.

The "New Deal"

The "New Deal" was an expression coined by Franklin D. Roosevelt in his speech accepting the Democratic Party's nomination for U.S. President in 1932, and has since come to describe the socio-economic policies and activities of his Presidential administration between its inauguration in 1933 and the United States' entry into the war in 1941.

The New Deal was directed primarily at the achievement of recovery from the Depression. In addition to efforts at improving the lot of labour (described on page 601), key New Deal legislation included the Agricultural Adjustment Act which initiated a revolution in American agriculture (right); the creation of the Tennessee Valley Authority (far right), which brought economic development to an entire region; and the Work Projects Administration, which authorised work for millions of Americans on Federally funded construction projects (below).
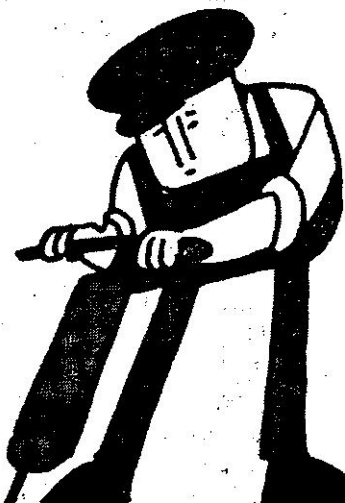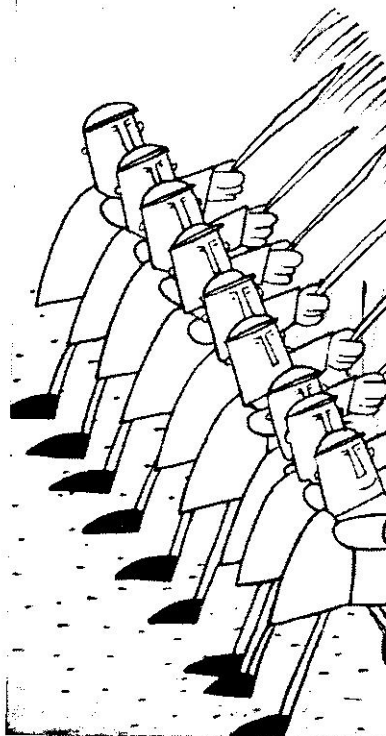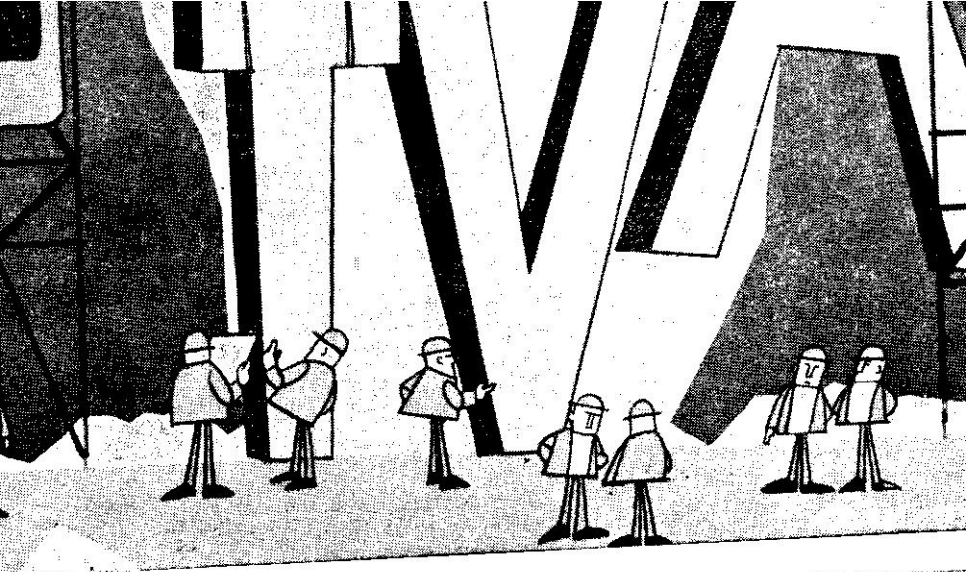
As workers demanded better conditions (above), management's fear of unions grew. While the proprietor watches complacently (below), a company guard forcibly evicts a union organizer from factory premises.
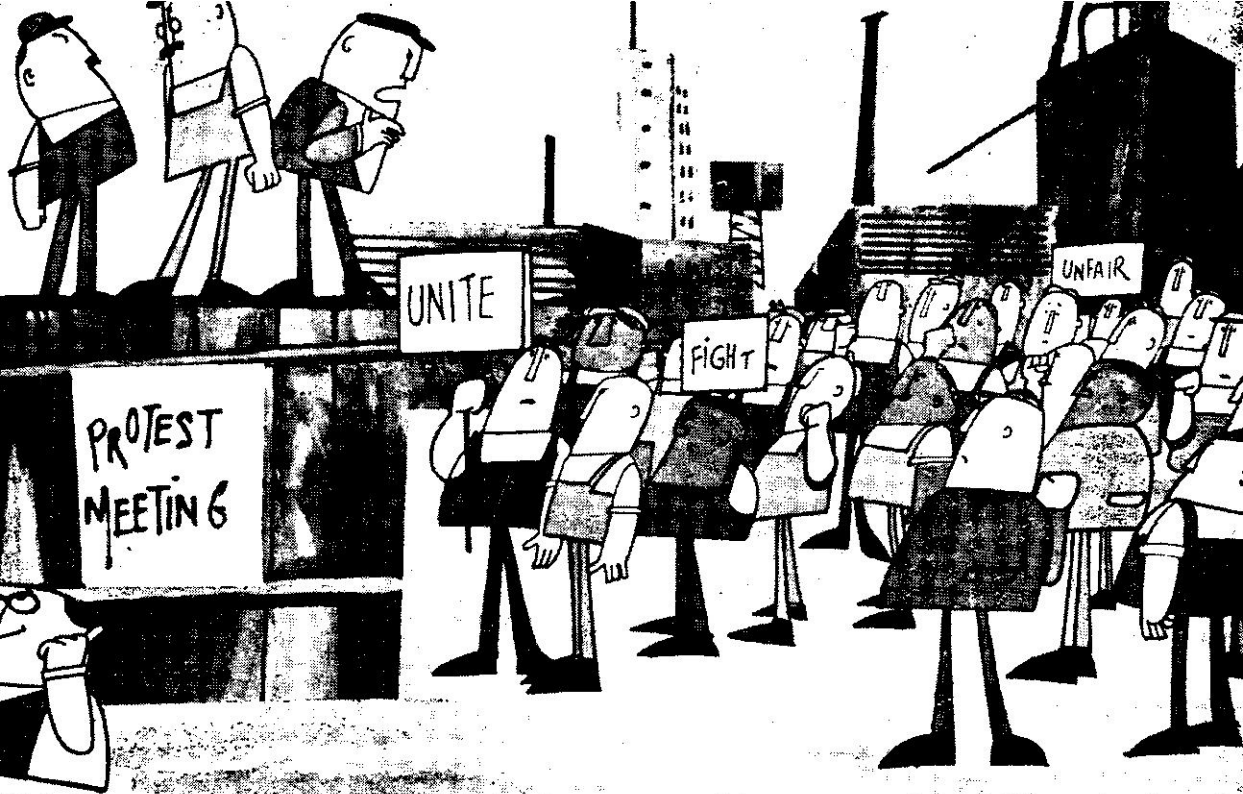
Subsequent agitation by workers seeking to form a union (above) was often met by the declaration of a lockout by the employer (below). Such bitter unrest led to enactment by the government of laws guaranteeing worker rights.
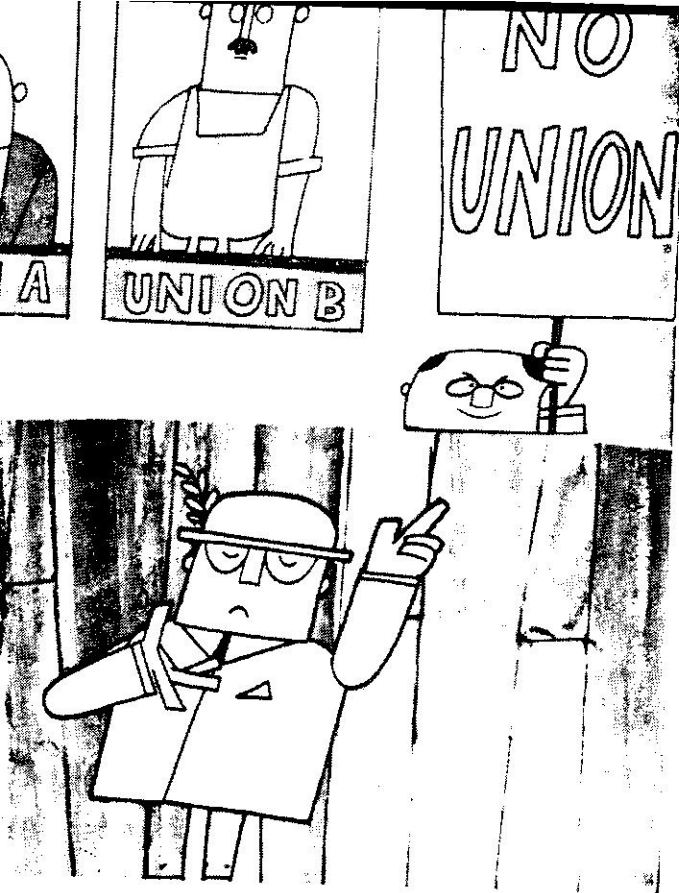
...the NLRB at wo

A comprehensive procedure for the selection
as the employees' bargaining representative
loped by the National Labor Relations Boar
a government agency.

On election day, an [NLRB] agent sets up
area (left). Only eligible employees are allow
Ballots are marked in privacy (right) and
the ballot box.

After th close of polling, the agent counts t
in the presence of the employer and union repres
(below). If a union secures a majority of valid
is certified by the NLRB as the exclusive ba
representative of all employees (bottom, right
majority of employees indicate' that they ar
favour of representation by any union, the resu
election are certified by the NLRB, which is t
hibited from conducting a fresh election for on

Both the employer and the victorious un
under a statutory obligation to bargain with ea
in good faith. NLRB rules prohibit discri
against employees because of union activities a
other unlawful labour practices by employers or
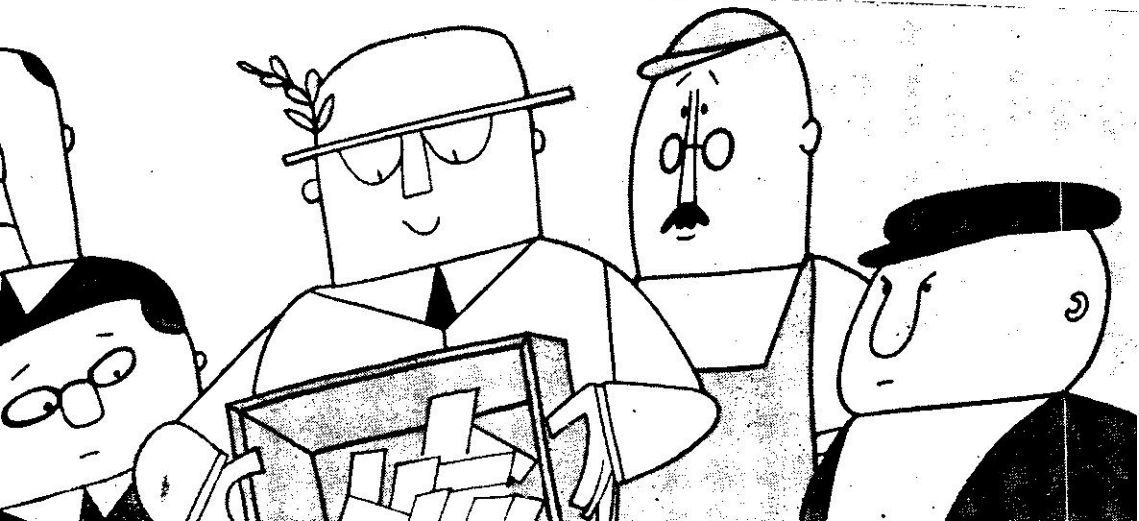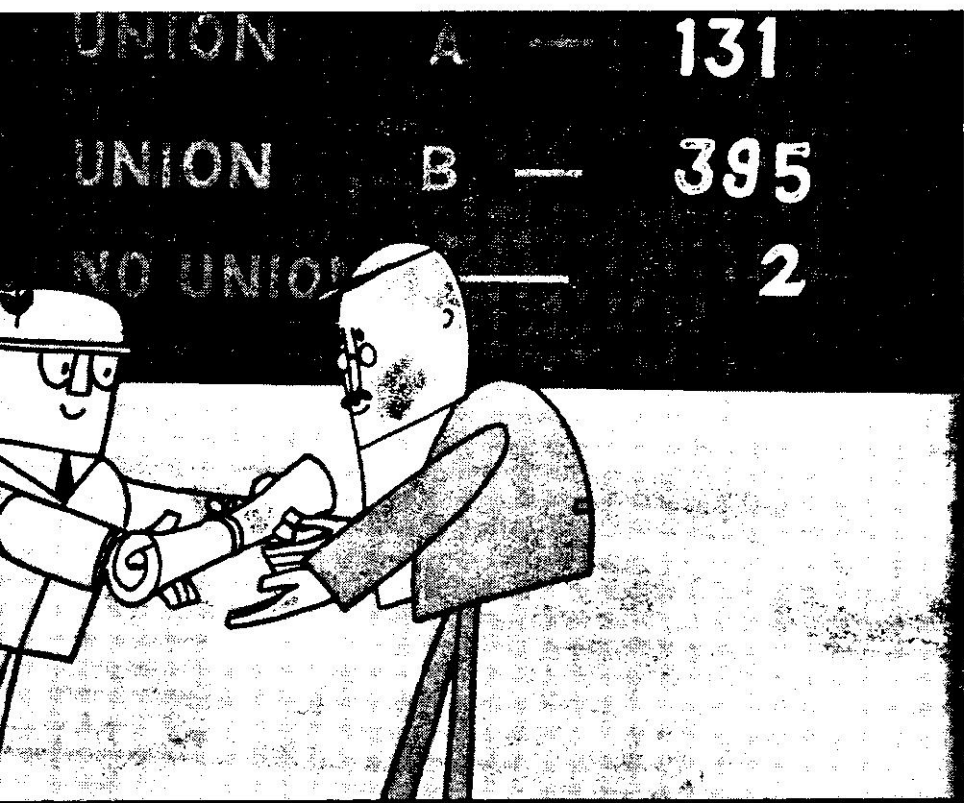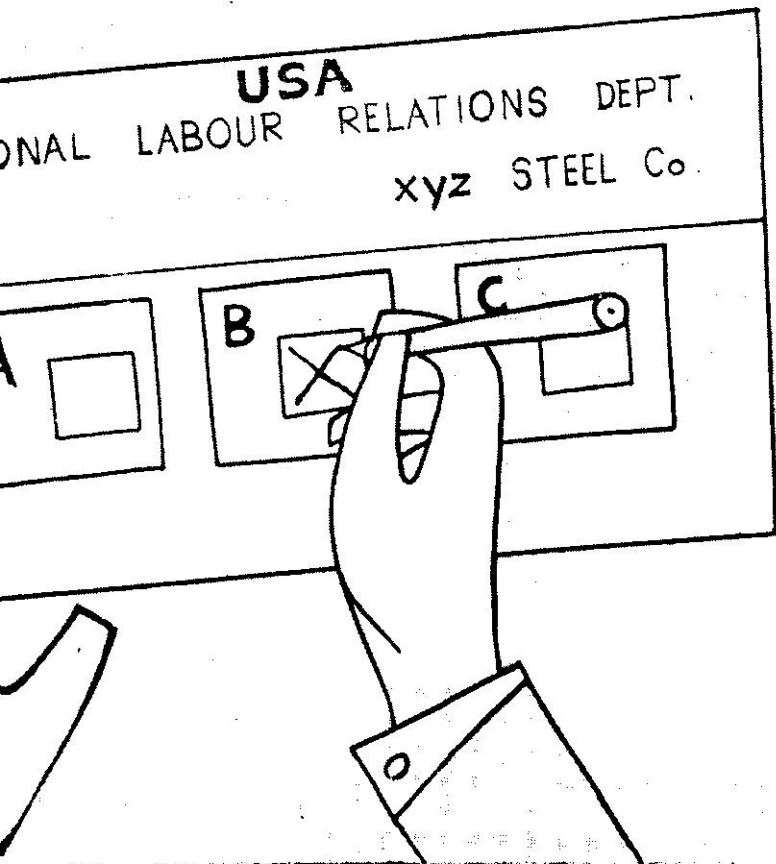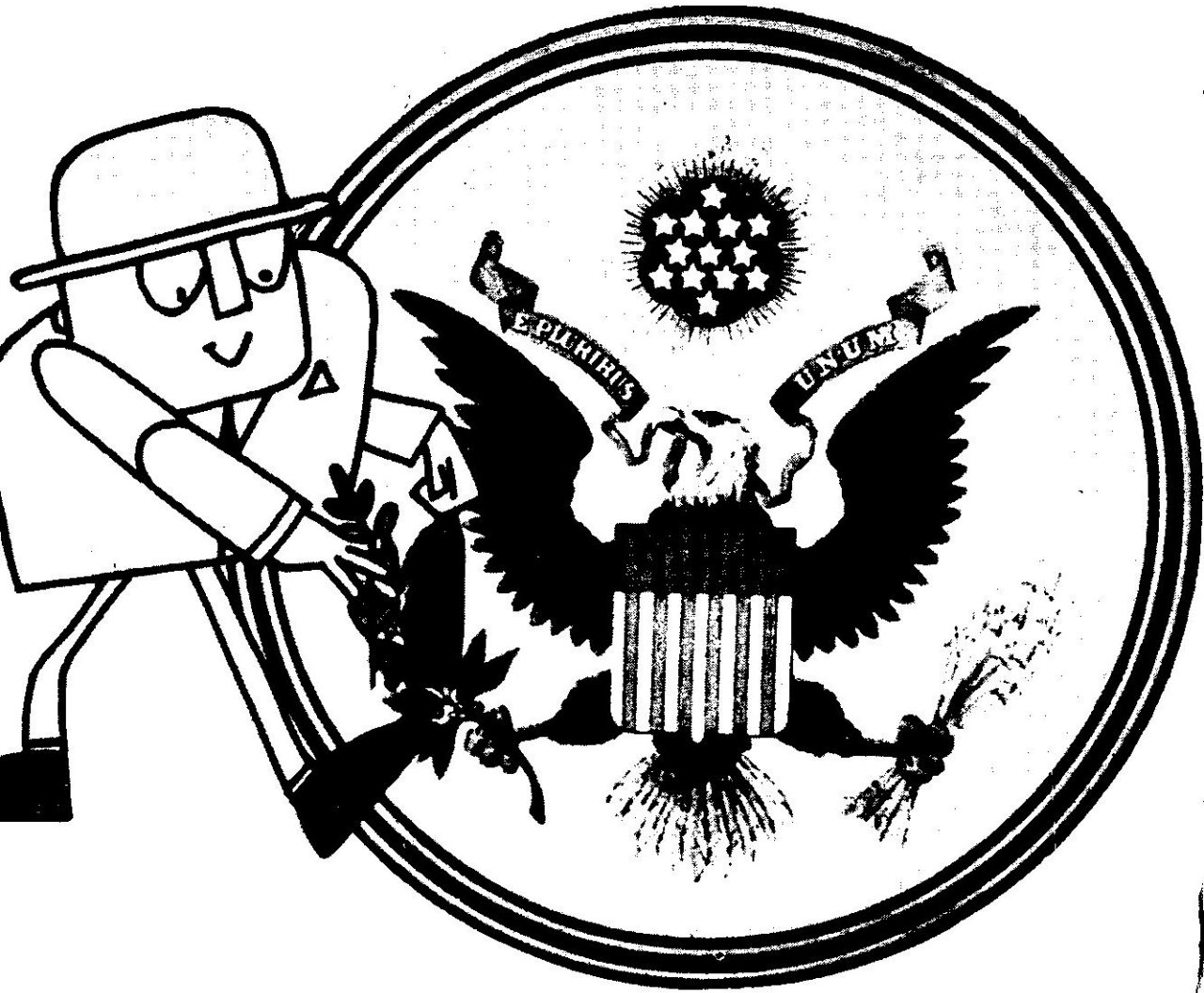
The Government steps in...

The administration of Franklin D. Roosevelt marked a definite turning-point in the fortunes of organized labour in the United States. The first piece of legislation to alter seriously the position of organized labour during the Roosevelt administration was the National Industrial Recovery Act of 1933. The most important years for American labour were those from 1933 to 1947. During this period, labour unionism as it presently exists in the United States was nurtured, and the move from strife to stability can most readily be seen.

In 1938, the US Congress passed the Labour Standards Act. The Act (1) established a [minimum] wage of 25 cents an hour, which [was] gradually to be increased to 40 cents; (2) [set the] maximum workweek at 44 hours, with the provision that it would be reduced to 40 [hours] within three years; (3) provided that all ov[ertime] would be paid at a minimum rate of on[e and] one-half times the regular hourly wage: ([4) pro]hibited the inter-state shipment of goods [manu]factured by children under 16 years of ag[e; and] (5) created a special Wage & Hour Divis[ion in] the Department of Labour to ensure com[pliance] with the new law.
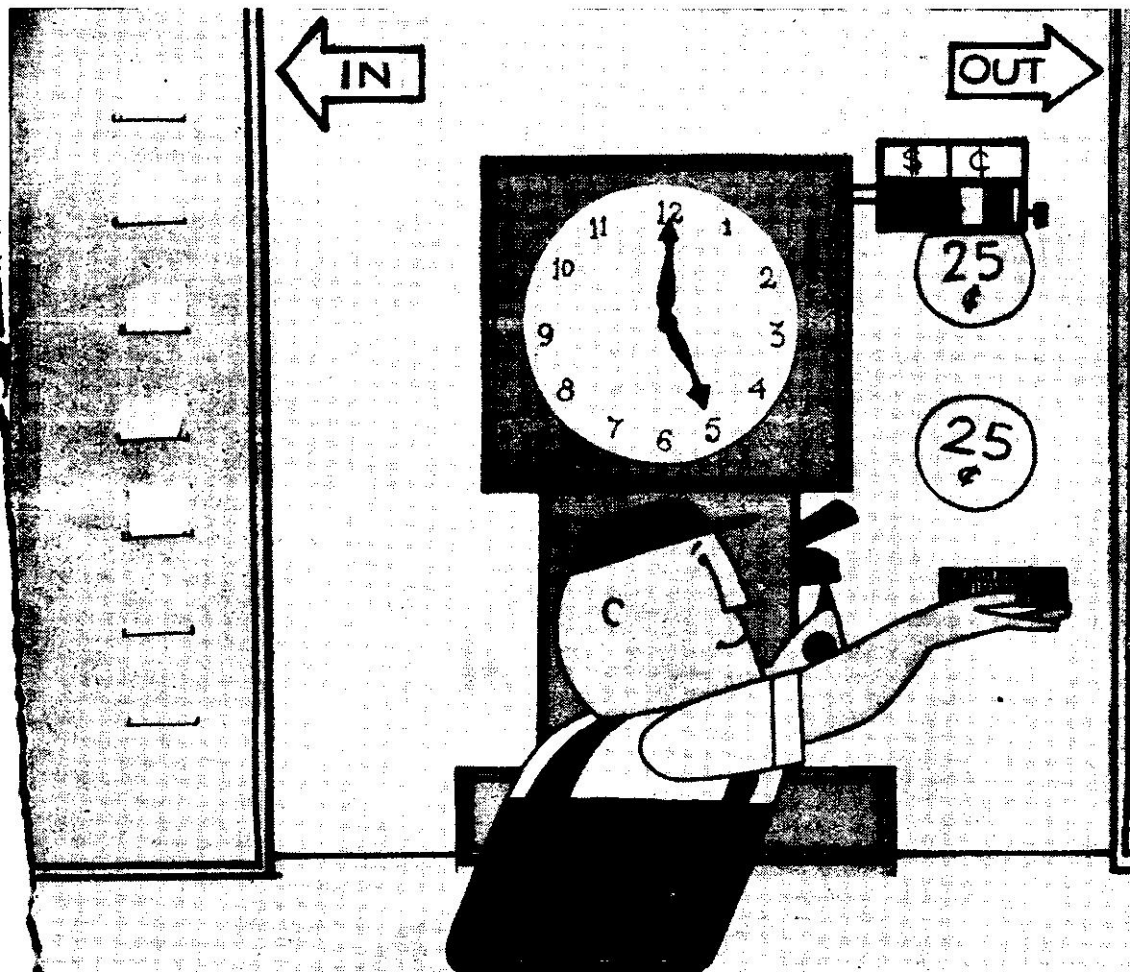
Collective bargaining

Collective bargaining may be defined as a process in which an employer and the representative of his employees negotiate, administer, and enforce an agreement covering wages, hours, and other conditions of employment. The right of the parties to participate in this process has been guaranteed by United States law for more than a quarter of a century. Today, collective bargaining, as reflected in more than 100,000 labour contracts, directly affects more than 18 million union members. Indirectly, it affects the wages and working conditions of millions of other workers.

The process of collective bargaining begins with the employer's recognition of the bargaining representative which has been chosen by the majority of his employees. As we have seen earlier, majority status is determined through a secret-ballot election conducted by the Federal government. NLRB certification of the victorious union gives it the exclusive right and duty to represent all employees in the bargaining unit.

The law also requires both labour and management to bargain in good faith (top, right) with a view toward reaching agreement on wages, hours, and other terms and conditions of employment. The threat of economic force in the form of a lockout (bottom, right) or strike (bottom, far right) is a key aspect of the negotiating environment. Once achieved, the agreement is put in writing and governs the labour-management relationship for a fixed period, such as two or three years. During this time, other unions are barred from representing the workers for collective-bargaining purposes. Moreover, most labour contracts prohibit strikes during the life of the agreement and provide that disputes over the meaning or application of the agreement be referred to the arbitration of a third party.

Collective bargaining has been a stabilizing factor in the free-enterprise system. First of all, it is a system for resolving economic conflict between employers and unions over basic working conditions. Secondly, it provides a legal forum in which the individual worker's rights on the job are protected. Thirdly, it provides a safety valve for the psychological and social conflict which is bound to arise in a relationship involving employers, unions, and individual employees.
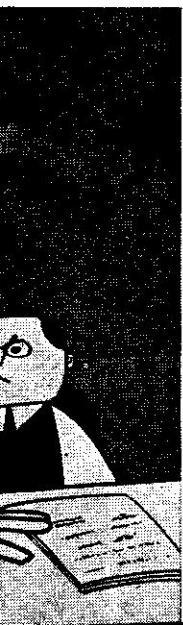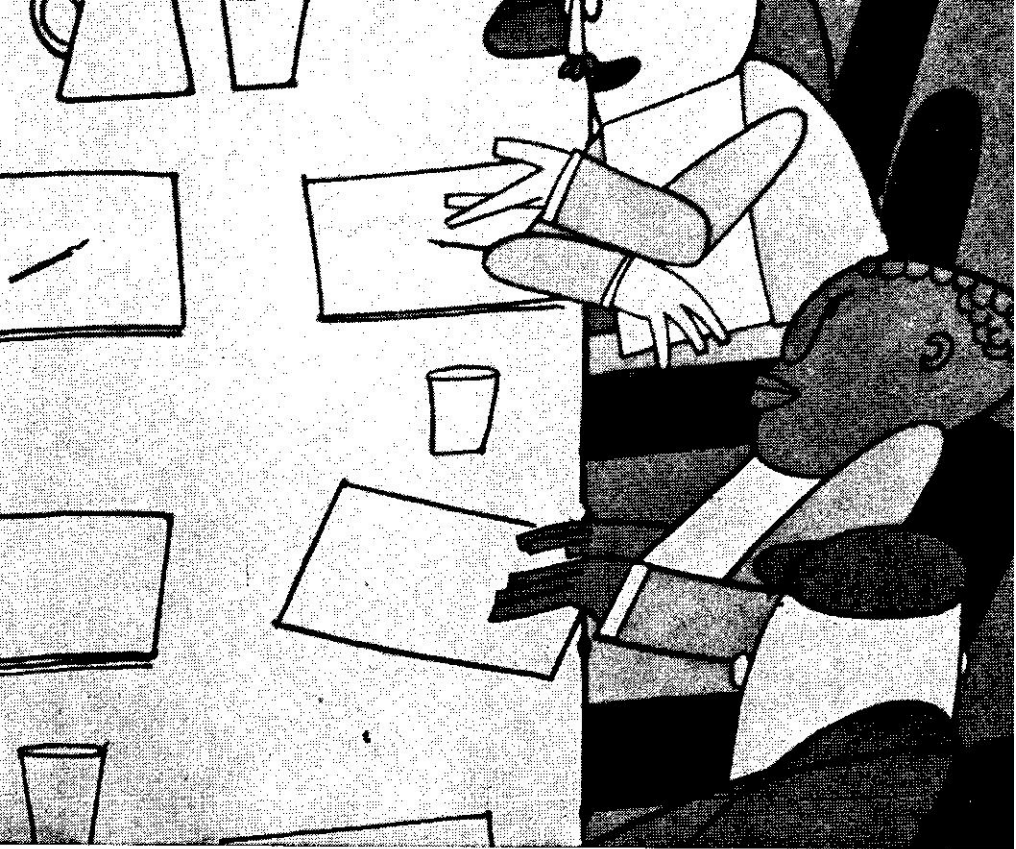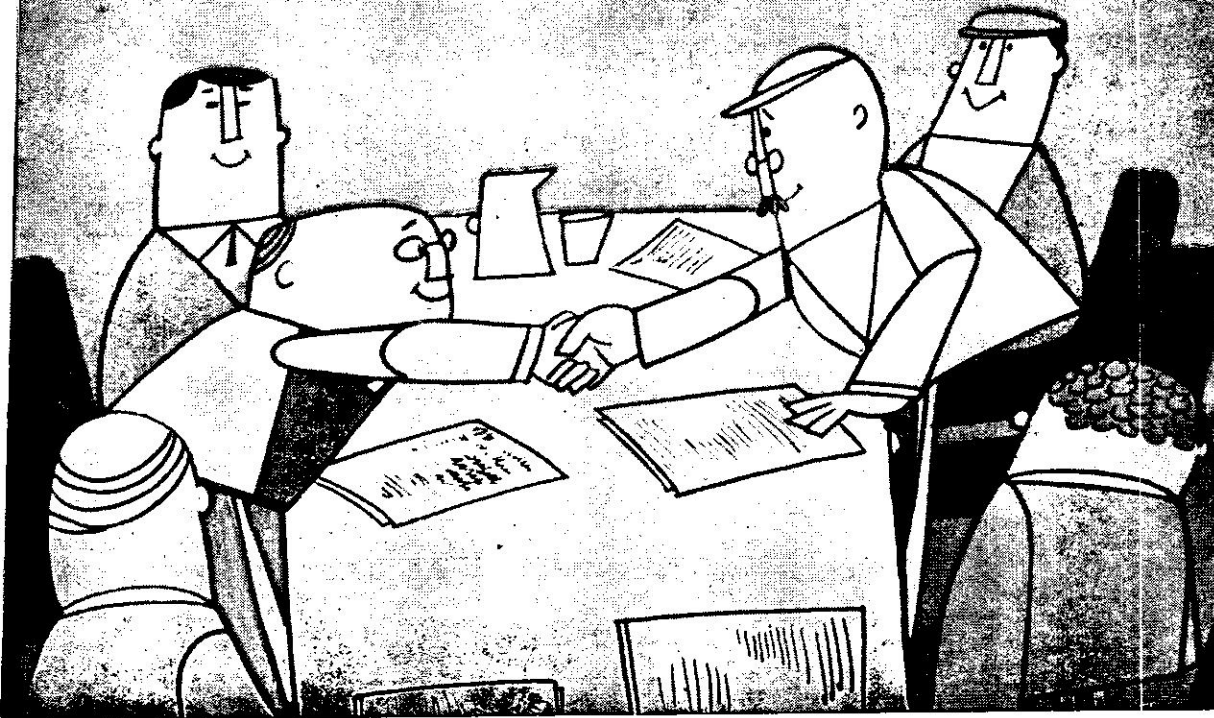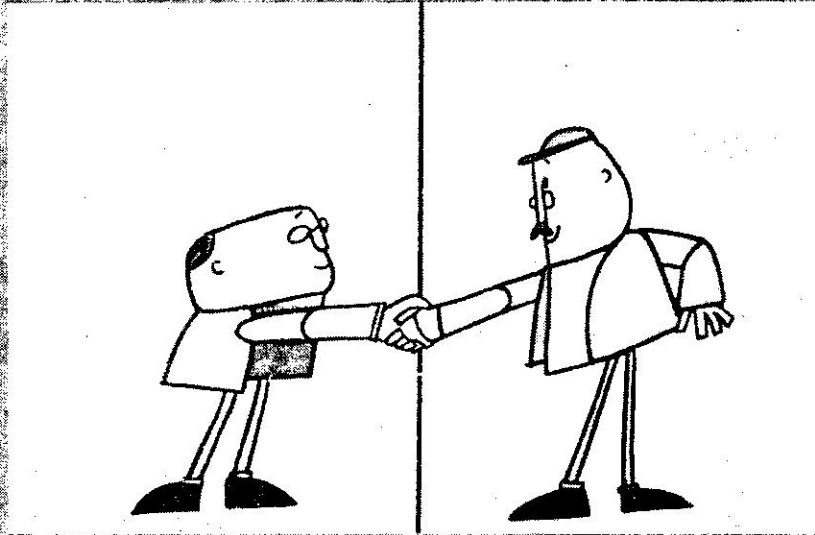
...Representatives of labour and management shake hands as they reach a mutually satisfactory agreement.

Working together in a common cause

The attack on Pearl Harbour brought labour and management further together in a common cause. Shortly after the United States entered the war on December 8, 1941, President Roosevelt called a conference of union and industry leaders. At the conclusion of the meetings, the President announced a voluntary pledge from union leaders not to sanction strikes for the duration of the war, in return for a pledge by management representatives not to sanction lockouts. These pledges were parts of an agreement leading to establishment of a National War Labour Board [NWLB] to consider all labour-management disputes affecting the war effort and to provide procedures for their peaceful settlement. This 12-member Board set up in January 1942 was composed of representatives from labour, management and the general public.

The task before the NWLB was not a simple one. Leaders of organized labour were concerned lest the hard-won protection for the right to bargain collectively be lost. Fortunately for labour, the NWLB had no intention of tampering with that right. On the contrary, it stood firmly behind labour's rights under the Wagner Act, even to the point of approving "closed shops" where a majority of workers in a bargaining unit favoured them.

The NWLB also inaugurated the "maintenance of membership" plan which was designed to protect unions from "raids" on their membership by rival unions. The plan provided protection by stating unions could retain their membership and the right to represent workers while a bargaining contract was in effect.

With World War II, wages rose rapidly, overtime increased and new positions in industry opened up for the unemployed. In an effort to fulfil increased demands for labour, women and older workers were drawn into industry.

During the war union membership steadily increased at the rate of about a million workers a year, with the greatest gains in the steel, shipbuilding, aircraft, automotive, and other war industries. Many unions between 1941 and 1945 doubled and tripled their memberships.

Collective-bargaining agreements were negotiated or extended over large sections of industry during the war. Strikes occurred, but union leaders and government representatives sought their speedy settlement. Some issues were postponed when it was found that they could not be settled within the existing framework of controls, thus building up pressures which erupted after the war.

With labour's fundamental rights secured, major problems confronted the NWLB. It is ironic that these problems grew out of the very rights which the NWLB sought to guarantee labour. Labour was free to bargain collectively, which meant it was free to bargain for higher wages.

However, increased wages aggravated the inflationary pressures on the American economy and threatened to hinder the effectiveness of the war effort. It was the job of the NWLB not only to protect the rights of labour, but also to protect the nation as a whole. Management could be of little help to the NWLB in this matter, for there were greatly increased profits to be made during this period and there was a definite shortage of manpower. In such a situation, management would normally be willing to pay higher wages to keep its factories manned. But a government body had to act if stability was to be maintained.

The "Little Steel" formula

As demands for higher wages increased, the government began to look for ways to limit them. In the early months of the war the cost of living increased so rapidly that it was difficult to justify not granting wage increases. As a general policy, the NWLB propagated the idea that workers were entitled to a standard of living "compatible with health and decency." The problem was that labour and the NWLB could not reach an agreement as to how much money it cost to maintain such a standard of living.

In July 1942 the NWLB decided to set forth a plan to govern wage increases. Under the so-called "Little Steel" formula, workers were granted a maximum wage increase of 15 percent above the level of January 1, 1941. This was designed to bring wages into line with the cost of living. Workers also obtained various so-called "fringe

Soldiers, sailors, and airmen, who were demobilized following the end of the war in 1945, rejoined the labour force.

benefits" such as paid vacations and holidays, shift differentials and insurance and pension plans. However, management, in a move to attract workers, frequently granted more than the authorized 15-percent increase.

The government finally stepped in to end these abuses. Under the Stabilization Act of October 1942, the President authorized the NWLB to forbid wage increases that worked to the detriment of the price-stabilization programme. The NWLB had the power, though, to permit increases in individual situations where special problems existed. Most labour leaders, although unhappy with the "Little Steel" formula, complied as much as was possible, short of sacrificing the interests of the workers they represented.

Barriers shattered

One source of workers, the Negro population, remained relatively untapped in the earlier part of the war, as employers continued to discriminate racially in their hiring practices. The situation was to change as the demands of industry, coupled with the Negro's efforts to remove existing inequities, resulted in the shattering of some of the barriers to employment of Negroes. Expanded employment of Negroes, particularly in the mass-production industries, necessitated their acceptance into the unions on an equal basis if standards of wages and working conditions were to be maintained. Key segments of organized labour vigorously supported this drive for racial equality.

Prejudices break down

In many unions, prejudices which had existed through the years gradually broke down as white and black workers learned to respect each other as fellow workers on the job. Some unions which had previously refused to admit Negroes to membership relaxed their rules and removed racial restrictions from their constitutions. The Federal Government's Fair Employment Practices Committee aided in eliminating some of the more severe instances of discrimination in industry.

The return to a peacetime economy was accompanied by renewed disputes between labour and management.
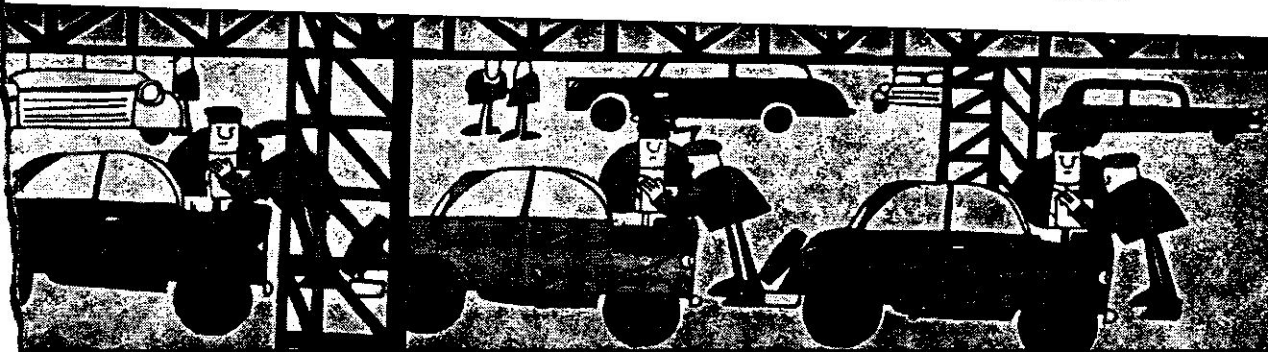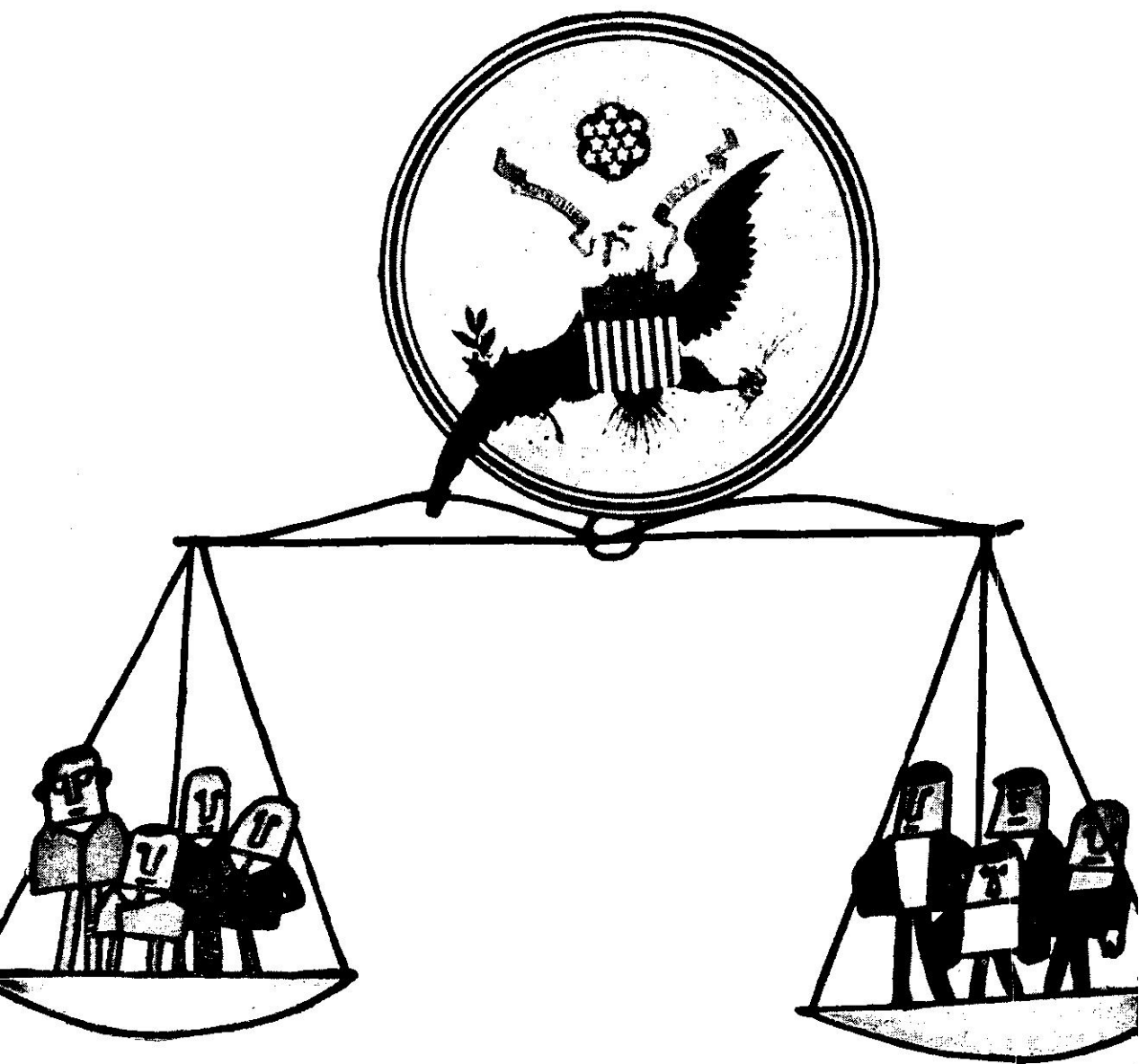
The Taft-Hartley Act sought to restore a "balance" of rights and responsibilities between workers and employers.
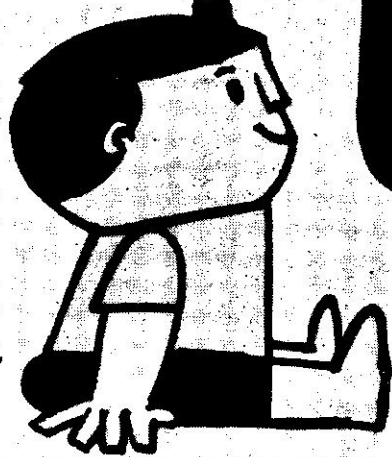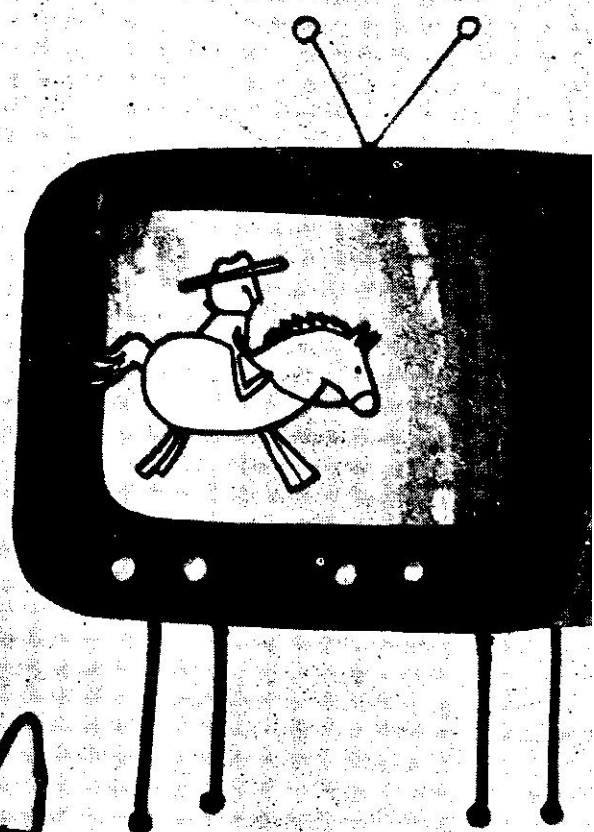
. . Increased pay packets (above) have resulted in an unprecedented rise in the standard of liv
he past 80 years, real wages have increased more than threefold. In addition, there ar

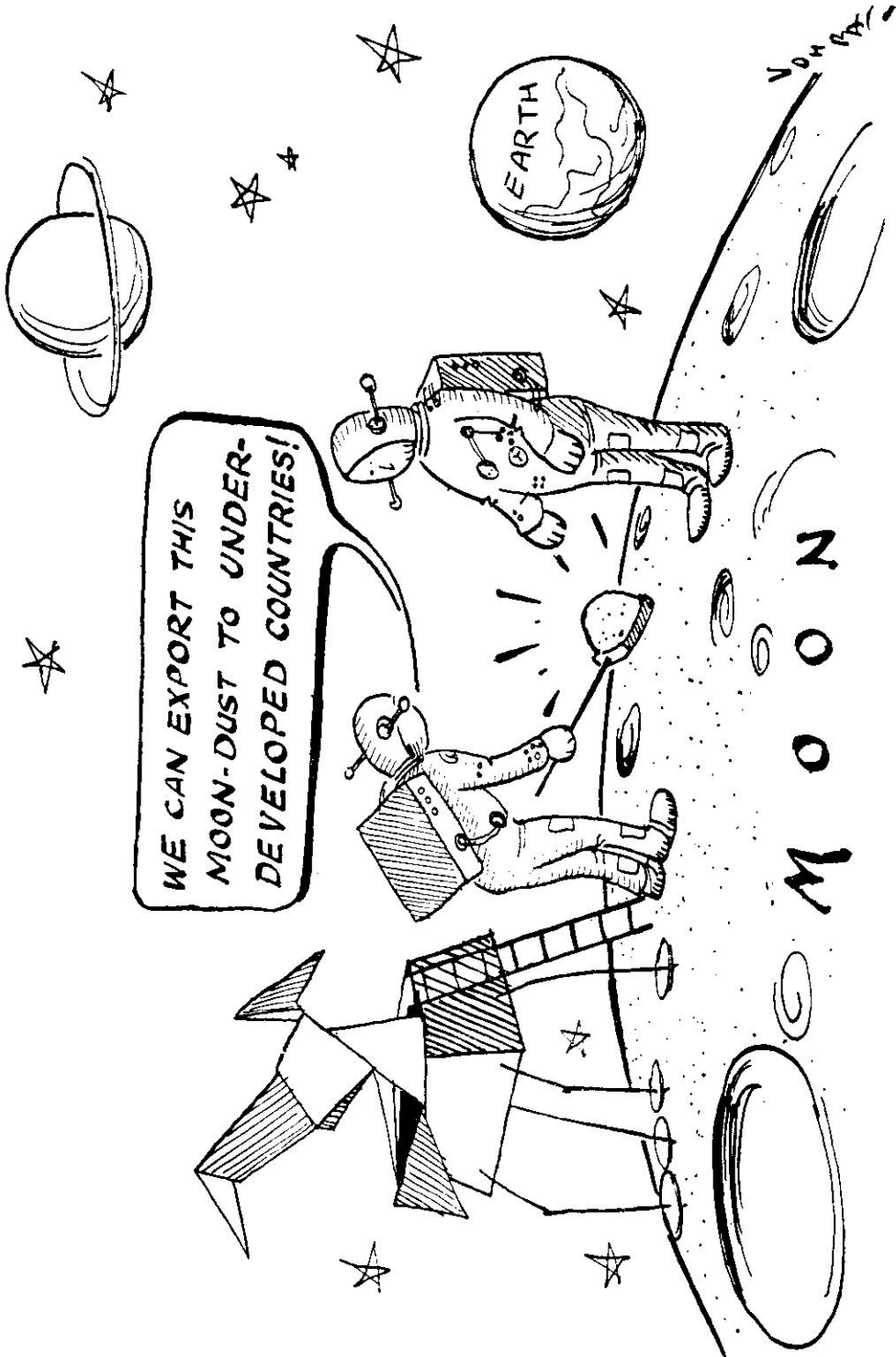# President Franklin Delano Roosevelt
on
Labour Organisation

"Organizations of workers, wisely led, temperate in their demands and conciliatory in their attitude, make not for industrial strife, but for industrial peace. The whole tendency of our modern civilization has been toward cooperation. Employers and employees alike have learned that in union there is strength, that a coordination of individual effort means an elimination of waste, a bettering of living conditions, and is, in fact, the father of prosperity...Capital is realising that without the friendly and intelligent cooperation of labour it cannot exist, and labour has learned that without the aid of capital it cannot earn its daily bread."

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