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Conspectus

IN THE FOCUS

Inventory Control

The present inflationary crisis has created a belief at least in some quarters of industry, that Inventory Control is no more a good economics as the cost of 'blocked capital' will be less than the cost of uncertainty in supply line due to shortages and the resultant unbridged rise in prices. However, if this pseudo-logic is scratched a little, it will be known that it is neither economics nor ethics, but plain speculative hoarding, a cause rather than an effect of shortages and price spiral. The purpose of bringing Inventory Control in the focus at this point of time is only to reiterate that 'Industrial Obesity' is not only anti-social but also an industrial disease for which Inventory Control is the only cure. *—Editor*

Inventory Models and the Problems of Price Fluctuations

The case of inventory control is in the identification of optimum size of stocks that will serve to minimise the costs and maximise the return on investment, ensuring at the same time the adequate and regular flow of materials and spares. The determination of the 'optimum size' is, however, difficult, as it is affected by a number of factors, quite often exogenous to a company. A well-worked out inventory policy must take care of these factors and help management to decide the largest economic order quantity at the most opportune time. This paper might help a working materials manager in evalutating his inventory policies . . . . . A.B. Lal (Page 137)

Some Problems Regarding Costs in Inventory Models

Since fixed costs have the largest share in the total cost, greater effort must be directed at reducing the fixed costs. It is always advisable to apply work study techniques for reducing the fixed cost of the system before any serious attempt is made to apply operational research techniques to inventory problems. Operational research techniques can help in reclaiming those savings which work study techniques fail to achieve . . . . . S.K. Goyal (Page 148)

Inventory Models and the Problem of Price Fluctuations

A.B. Lal

The increasing size of business establishments is responsible for promoting the idea of conscious and scientific inventory control. Inventory is a major constituent of the working capital of a firm. Frequently as much as one third of a firm's total investment is in the form of work-in-process, finished goods and stores inventory. Of the three, stores inventory usually represents the largest value. Stores inventory includes raw materials, parts and factory supplies etc. In this article the discussion is confined to the problem of inventories of raw materials and factory supplies.

The levels of raw-materials inventories are usually calculated on the basis of current production schedules, and a change in the level of production calls for a consequent adjustment in inventory levels. The adjustment in turn causes a change in the requirements from the vendor. The purchasing section of the firm has to understand clearly what, when and how much the organisation wants; what, when and how much the suppliers are willing to supply; and effectively match the needs of the organisation with the availability of suppliers in the market. The right approach to the inventory problem requires an assessment of all the relevant factors which can contribute to maximize the return on investment.

The heart of inventory control resides in the identification of optimum size of inventory which will serve to minimize the company's costs and maximize the return on investment, at the same time ensuring that adequate supply will be available as and when required. But its determination is complicated as it affects the inventory investment through a number of variables both endogenous as well as exogenous.

Economic Lot-Size Model*

Earliest inventory problems subjected to mathematical analysis were

* R.H. Wilson, Harward Business Review, 13 No. 1(1929)
See also F.E. Clark, Harward Business Review, 6(1927-28)

those involving the determination of economical purchase quantities. Inventory costs consist of two components—ordering costs and carrying costs—which tend to move in opposite directions. Ordering costs are fixed per order but tend to decline per unit as the size of order increases. Carrying costs increase roughly proportionately with the size of order. The annual cost of carrying inventories has been estimated to vary between 15 and 25 percent of the total value of inventories, which includes interest on capital, cost of handling, storage, deterioration, obsolescence and insurance. Given the annual requirement of inventory, the problem is in what lot sizes to make the purchases, so as to minimize the sum of the inventory ordering costs and carrying charges. The formula for arriving at the Economic Order Quantities (EOQ) is as follows :

$$Q = \sqrt{\frac{2RS}{I.C}}$$

where,

R represents the number of units demanded per year ;

S the costs which vary proportionately with the number of orders placed;

I price of each unit ; and

C carrying cost expressed as a percentage of average inventory.

In dealing with economic order quantities, we often assume that the rate of usage is uniform and that the time interval between ordering and receiving of goods (known as lead time) is constant. When the lead time is known exactly, the reorder point gives the level of inventory at which the purchasing agent should place a buying order to replenish the stock.

Reorder point = Usage rate per day x Lead time in days.

But these assumptions do not always hold good in practical life. Planned usage of raw material, for example, can be thrown off the schedule by an increase in the sales volume over the projected level, by its decline due to strike, power failure or weather changes. Similarly, the lead time between ordering raw material and getting delivery often varies as the supplier may run into difficulties due to fire, breakdown caused by accidents etc., or transportation bottleneck.

Stock-Out Cost

The stock-out cost of an item is the loss that may result if the item is out of stock. It does not enter into the EOQ formula because in working it out, it has been assumed that there will be no stock-out. More sophisticated formulae take into account stock-out cost and other factors like quantity discount and lower transportation cost. It is to be noted here that stock-out cost is not related to the price of the item but to the extent of disruption that the shortage can cause to production. For instance, if an essential item of raw material, not readily available in the market, goes out of stock and if the production lost until the stock again arrives is worth Rs. 5,000 then the stock-out cost is Rs. 5,000 even though the required raw material may cost only, say Rs. 50.

Stock-out cost varies from item to item. If the stock-out cost is low, there is no need of having large reserve stocks, but if the stock-out cost is high, a larger buffer stock than usual is necessary.

Optimum Safety Stock

The optimum safety stock to carry is determined in the light of two goals, often conflicting with each other ; these are (1) to minimize the costs of stockout, but (2) at the same time to minimize carrying costs of the safety stock. The decision of how much safety stock to carry is not easy. Usually, a service-level policy is the answer suggested when an accurate determination of the cost of being out of stock is difficult.

The Service-Level Approach

Organisations which use this approach simply establish the probability of being out of stock they are willing to "live-with". They then take whatever safety stock action is required to keep the probability of being out of stock at or near this point. Because no organisation can afford a 100 percent service-level (requiring an infinite level of safety stock), firms choose a service level which appears to them to be a reasonable alternative. For instance, a company might adopt a service-level policy of 95 percent on a certain item in its inventory. In many cases this is done completely.

Probabilistic Lot-Size Model

Safety stock varies with the length and variability of the lead time, the rate of variability of usage, and the degree of service the firm wishes to give to its customers. Recent work in the theory of Inventory Management deals with problems in which usage rate and lead times are not known with certainty. In such studies it has been assumed, with some justification, that usage rate and lead times are random variables with known probability distribution which can be determined by collecting data from our past experience and future known trends, statistical analysis and applying probability theory. It is assumed that all demand distributions are stationary and independent over time.

The amount and timing of replenishment is found by considering expected costs of holding and cost of stock-outs. Optimal condition for safety level is obtained when its carrying cost and stock-out costs are both at a minimum. Accurate determination of safety stock by taking into account all these factors involve complicated mathematical computations requiring the use of electronic data processing equipment. A rough assessment can be made on the basis of observed deviations from average demand and average lead time over a reasonably long period in the past, and the number of stock-outs during the same period. In probabilistic systems we can only minimize the expected costs rather than actual costs.*

When forecasts of lead time and usage are accurate the maximum inventory is equal to order quantity plus the safety stock and the minimum inventory is equal to safety stock. If usage is steady, the average inventory equals half the order quantity plus the safety stock. The economic lot size is increased in the probabilistic case as the fewer the numbers of orders placed, the smaller is the expected number of stock-outs. The introduction of stock-out costs make it worth while to buy in larger quantities.

* The following formula has been proposed by some writers on the subject :
Safety Stock = $P \times K \times$ Average demand $\times \sqrt{\text{Demand per lead time}}$
where P is a constant related to order frequency and K is another constant used as calibrater to bring theory into relative position with actual experience by the analyst. According to this formula, the safety stock is proportional to the product of average demand and square root of demand per lead time. -See for ref. "Management Accounting" by Bahadur Murao, Minakshi Prakashan, Meerut.

In case of large requirements of major items of inventory, it is not always advisable to buy strictly according to the economic order quantity originally fixed on the basis of carrying and procurement costs. Changes in tne market and in the economy as a whole are likely to alter the balance between the various parameters by increasing the effect of some and almost eliminating the effect of others, thereby creating a virtually new situation that calls for a new inventory policy. For instance, economic influences on national inventory specially created by government control on price and distribution of scarce materials may lead to peculiar inventory problems.

Price Changes and Inventory Policy

Price fluctuations of materials, among other determinants of the purchase order size, may have a marked effect on the procurement policy of a firm. If these fluctuations are to be used to some advantage, materials have to be purchased in adequate quantities when prices are low. Sometimes it is worthwhile to purchase in smaller quantities when prices are high and are expected to come down, and to purchase larger quantities in anticipation of a price rise.

The influence of price changes on inventory policy has been recognized and referred to in the existing literature on Inventory Management. However, in the various inventory models developed so far, the problem of adjusting price-changes to inventory procurement policy has been left out. The purpose here is to develop an inventory-model which takes into account the influence of price changes in the determination of EOQ. Industries depending on raw materials, especially basic raw materials have to pay a great deal of attention to market prices, and some firms regard price fluctuations so crucial that major policy decisions and the firm's resources become fully geared to the activities of the purchasing department.

In advanced countries, more and more reliance is being placed on market research for purchasing instead of depending upon tenders, quotations and price lists of a few suppliers. This enables the purchasing department to have a general knowledge of the existing price levels and fluctuations in different parts of the country so that they can obtain most favourable rates, take advantage of any trend in price

changes, prevent malpractices, keep abreast of new technological developments in the field of materials and set up norms for price negotiations with suppliers.

Materials and components may be cheaper when purchased in larger quantities owing to larger discounts and lower transportation costs. Furthermore, paper work and inspection of incoming goods are often simplified when larger quantities are ordered. On the other hand, capital is tied up in dormant goods, more storing space and more handling and maintenance of goods in store is required, and greater losses due to deterioration and obsolescence are expected.

Larger discount or lower transportation cost need not necessarily be profitable. One has to compare the benefit of discount, lower transportation cost or price differential with the inventory cost. Similarly if there is a sliding scale discount, one should consider what percentage of discount is advantageous. It may be possible that buying goods of the same value in two lots and receiving 3% discount is advantageous than buying in one lot at 5% discount.

Orders on the basis of economic order quantity can be placed only when materials are readily available. When delivery time is long, one will find it convenient to place orders for six months' requirements. in such cases efforts should be made to stagger the delivery. When materials are recouped by either fixed internal or periodic review system of recoupment, orders are generally placed for 3 months or 6 months as per requirements, depending upon the quantity involved, value, lead time etc. If the quantity of any item is large, delivery may be staggered, but if the quantity is small delivery may be obtained in one lot. In India import licences are issued on half-yearly basis, the order quantity for imported items is inevitably for six months requirements, although it may be possible to stagger delivery in certain cases. The same may be suggested for slow-moving items and seasonally available items.

Purchasing for contingency reserves or forward buying means to buy at a time when prices are lowest for a particular item, with prospects of future incease in price. This practice is often applied to materials that experience seasonal price fluctuations. It is also appropriate when there is a prospect of inflation or of storage of supply. For instance, a concern may ordinarily consume 2000 tons of steam coal in a year.

The firm may buy all this coal in July, anticipating that the price will be higher on account of seasonal demand or because a miner's strike is threatened. In another case of Vanaspati manufacturing firm, the new groundnut crop comes to the market by early November and on account of limitations of several factors like holding capacity, warehousing and credit facilities, the tendency on the part of the farmers is to dump the produce in the market quickly. This obviously results in low prices at the beginning and high prices towards the end of the season. It, therefore, becomes necessary to build up future raw material requirements in such a way as to keep down the stock losses to the minimum.

It must be recognized that this type of forward buying incurs the risk of incorrect forecasting of price trends and inventory needs. The possible gain in price may be offset by cost of storing and financing a large inventory. However, when the buyer is able to forecast conditions with reasonable chance of success and when there is adequate storage space and capital resources, forward buying can be very profitable to the enterprise.

Purchasing the Largest E.O.Q. at a Lower Price

In order to take advantage of lower prices at the beginning of the season or at any other time we have to fix the largest order quantity that is economical to order at that price. The optimum point under this suggested approach is the point where the reduction in ordering cost and in unit price is equal to the additional carrying cost which results from buying larger amounts.

Let
- X = Largest order quantity economical to order at the lower unit price (expressed in Rs.) ;
- A = Annual requirements in Rs. ;
- D = Percentage of difference in prices (calculated on the basis of past records of 2/3 years) over a certain period ;
- P = Ordering cost per order ;
- Q = E O Q in Rs. prior to taking advantage of price change ;
- C = Carrying cost as a percentage of average inventory ;

The first step in solving for X is to compute the amount by which carrying cost will rise once we start buying in large quantities.

Carrying cost for the proposed plan is determined in the following manner :

$$\underbrace{\frac{\text{Largest order quantity economical to order at reduced price}}{2}}_{\text{(New average inventory)}} \times \underbrace{\text{Carrying cost}}_{\text{(expressed as \% of average inventory)}} = \frac{X}{2} \cdot C$$

Next, we subtract from the carrying cost for the proposed plan the carrying cost of our present plan, the carrying cost under E O Q before taking advantage of lower price.

$$\frac{\text{This carrying cost is E O Q in Rs. before taking advantage of lower price or at offseason price}}{2} \times \text{Carrying cost} = \frac{Q}{2} \cdot C$$

The additional carrying cost amounts to

$$\frac{X}{2} \cdot C - \frac{Q}{2} \cdot C = \text{Additional carrying cost} \qquad (1)$$

Now we shall determine the reduction in the ordering cost. This reduction is found by subtracting the new ordering cost (when taking advantage of lower price) from the ordering cost which prevailed before.

$$\text{Old ordering cost} = \text{No. of orders per year} \times \text{ordering cost per order}$$

$$= \frac{\text{Old annual usage (in Rs.)}}{\text{amount of old orders (in Rs.)}} \times P$$

$$= \frac{A}{Q} \cdot P \qquad (2)$$

$$\text{New ordering cost} = \text{No. of orders per year} \times \text{ordering cost per order}$$

$$= \frac{\text{New annual usage (in Rs.)}}{\text{amount of new orders (in Rs.)}} \times P$$

$$= \frac{A\,(1-D)}{X} \times P \qquad (3)$$

Subtracting equation (3) from (2), we get decrease in ordering cost.

Therefore,

$$\frac{A}{Q} \cdot P - \frac{A(1-D)}{X} \cdot P = \text{Reduction in ordering cost} \qquad (4)$$

And Percentage of Price Difference × Annual requirement in Rs. before taking advantage of low price or discount.

$$= D \cdot A \qquad (5)$$

= Reduction in total cost of units because of lower unit price.

By equating the addition in carrying cost with the reduction in total buying price plus the savings in ordering cost we can obtain the value of X. Thus, from equations 1, 4 and 5 we get.

$$\frac{X \cdot C}{2} - \frac{Q \cdot C}{2} = D \cdot A + \frac{A \cdot P}{Q} - \frac{A(1-D)P}{X}$$

To solve for X, multiply both sides of the equation by X; we get

$$\frac{X^2 \cdot C}{2} - \frac{X \cdot Q \cdot C}{2} = X \cdot D \cdot A + \frac{X A P}{Q} - A(1-D)P$$

Converting in the form of a quadratic equation, we get,

$$\frac{X^2 \cdot C}{2} - \frac{X \cdot Q \cdot C}{2} - X \cdot D \cdot A - \frac{X \cdot A \cdot P}{Q} + A(1-D)P = 0$$

$$\text{Or, } X^2 \cdot \frac{C}{2} + X\left(-\frac{Q \cdot C}{2} - D \cdot A - \frac{A \cdot P}{Q}\right) + A(1-D)P = 0$$

$$\text{Let } a = \frac{C}{2}, \quad b = -\left(\frac{Q \cdot C}{2} + D \cdot A + \frac{A \cdot P}{Q}\right).$$

$$c = A(1-D)P$$

We are now able to solve the quadratic formula,

$$X = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{\frac{Q \cdot C}{2} + D \cdot A + \frac{A \cdot P}{Q} \pm \sqrt{\left(\frac{QC}{2} + DA + \frac{AP}{Q}\right)^2 - 4\frac{C}{2}\left[A(1-D)P\right]}}{2 \cdot C/2}$$

$$= \frac{\frac{Q \cdot C}{2} + D.A + \frac{A \cdot P}{Q} \pm \sqrt{\left(\frac{QC}{2} + DA + \frac{AP}{Q}\right)^2 - 2CAP(1-D)}}{C}$$

This gives the largest order quantity economical to buy when taking advantage of lower price.

**Timing of Purchases :*

No single formula can be suggested which may be applicable to the timing of purchases in all situations. However, a general procedure may be adopted to take advantage of the price changes.

1. *Estimation of Materials Needs :*

Materials manager should try to make estimate of materials consumption at least for 3 or 4 quarters ahead. In addition, he should try to get a more tentative estimate of material needs for a five-year or even a ten-year period. Both the long and short-term estimates may be revised at intervals to bring them in line with the latest sales projection supplied by the company's market research department. Estimates should be based on the best available forecasts. Materials manager can buy "ahead" of material requirements.

2. *Development of Tentative Plan of Purchases :*

At this stage in his planning, materials manager should ignore the

* See for ref. "Materials Management" by W. Miller.

effect of future price changes and the like on his purchase timing. He should break up his requirements into economic lots and programme their delivery, allowing sufficient lead time to prevent stock-outs if suppliers fail to adhere to delivery schedules.

3. *Watch for Buying Opportunities :*

Whenever prices look unusually favourable, the materials manager should consider buying in excess of requirements. He should work closely with his company's financial officials on foreward buying. Most of the Companies have limited funds available for forward buying, and the amount available can vary from month to month. While proposing the formula for making an estimate of the largest quantity to be purchased at lowest price, it is assumed that the firm has adequate finances and storage space etc.

When a buying opportunity does come, the materials manager is faced with the timing problem. The Bayesian decision rule and probability theory can be helpful. It should be noticed here that the price change becomes a prior (or first) probability rather than a conditional (or secondary) probability as does in other cases, e.g. the possibility of a steel strike followed by a possible price increase.

The advantage of the proposed formula is that it encourages stock accumulation when prices are low and discourages it when they are high. However, the buyer is not protected against severe price drops, since he will use up his fund before the bottom is reached. Nor will he be buying most advantageously should price inch up progressively throughout the year. This formula may be used to suit the needs of the materials manager.

Some Problems Regarding Costs in Inventory Models

S. K. Goyal

There are widely held misconceptions about the costs to be included in the mathematical models for inventory control. Due to these misconceptions, wrong cost elements are included which give erroneous results. The basic inventory control model is simple and perhaps that is the main reason of these misconceptions.

The model :

Let X — the uniform demand per year,

C_o — manufacturing cost per unit,

C_1 — set-up cost per set-up,

C_2 — stock holding cost per unit per year.

Hence the annual cost of supplying demand will consist of

(a) Manufacturing cost $= X. C_o$

(b) Stock holding cost $= \frac{1}{2}. q. C_2$

(c) Set-up cost $= \frac{X. C_1}{q}$

The annual cost 'C' will be equal to

$$C = X. C_o + \frac{X. C_1}{q} + \frac{1}{2}. q. C_2$$

As (X. C) is fixed once a decision has been taken to supply the entire demand, only then the variable cost 'V' is left for investigation.

$$V = \frac{X. C_1}{q} + \frac{1}{2}. q. C_2 \qquad (1)$$

Differentiating with respect to q and putting $\frac{dV}{dq}$ equal to zero, we get

the optimum batch quantity 'q_o' and the least variable cost V_o

$$q_o = \frac{\sqrt{2.X.C_1}}{C_2} \quad (2)$$

$$V_o = \sqrt{2.X.C_1.C_2} \quad (3)$$

The expression for q_o is of utmost importance and it acts as a spring board for developing and applying more complicated but realistic models to inventory control problems.

It should be noted that the optimum batch quantity depends on the square root of $\frac{X.C_1}{C_2}$. So if there are errors in determining X, C_1 or C_2, then the optimum batch quantity may not change significantly. However, there is a possibility of errors compensating themselves and the optimum batch quantity may be obtained just by chance. On the other hand the effect of errors, in determining the annual savings as a result of producing in optimum batch quantities can be considerable, thereby giving a false figure for the annual savings. Based on such false savings, unsound decisions might be taken, which will tend to undermine the performance of the system.

Most of the text books dealing with inventory control problems give the following interpretations for different costs involved in inventory control problems.

Manufacturing cost : The help of cost accountants is generally sought in determining this cost. The works cost is generally taken as the manufacturing cost per unit. The works cost is obtained by determining;

	(in Rs.)
Direct costs :	
Direct material	.....
Direct labour	.....
Direct expenses	.....
Indirect costs :	
Works overhead	.....
Total	

Set-up cost per set-up : This includes cost of setting-up operations, any wastage during a set-up and all costs which may have to be incurred in a set-up.

Stock holding costs : These costs are normally of a type which may be expressed per unit per unit of time. It may include the cost of (or interest on) money invested in inventory, the cost of storage space, insurance charges and obsolescence.

Now with the help of an example, the misconceptions about costs in inventory models will be explained and the correct way of dealing with such problems will be dealt. The example is based on a wider study undertaken in a small company.

Problem :

1. *Annual demand :* = 12000 = X

2. *Set-up cost :* (in Rs.)

direct wages	2.40
bonus	0.30
wastage	0.25
overhead	4.25
	7.20 = C_1

3. *Manufacturing cost :* (in Rs.)

material	0.58
wages	0.50
bonus	0.12
machine running	0.10
overhead	0.70
	2.00 = C_o

4. *Stock holding cost :* Total stocks currently held valued at

work cost = Rs.	200000
Interest charges	
@ at 10%	20000
wages	16000
insurance	1000
@ at ½%	
rent, rates etc	11000
	48000 = C_2

Stock holding cost expressed as percentage of investment in stocks = 24% or C_2 = Rs. 0.48 per unit per year. At the moment the present production capacity is 100% utilised. However, extra capacity can be obtained by keeping workmen on overtime. It costs Rs. 5 per additional set-up required over the number of set-ups required currently. The current batch quantity is 2000.

Solution : As the present utilisation of machines is 100%, so if the batch quantity is reduced below 2000 then we will have to spend extra money. In order to include this element of cost, the following modification is required to equation (1).

$$V = \frac{X.C_1}{q} + \frac{1}{2} q. C_2 + 5 \left[\frac{X}{q} - 6 \right] \qquad (4)$$

6 is the number of set-ups currently required in a year.

Substitute X = 12000, C_1 = Rs. 7.2 and C_2 = Rs. 0.48 in equation (4).

The annual variable cost with different values of q is given in table 1.

Based on this analysis, the optimum policy is obvious. Policy should be to produce in batches of 800 units. The annual savings will be Rs. 177 (500-323).

TABLE 1

(in Rs.)

q	$\frac{12000 \times 7.2}{q} + \frac{1}{2} q \times 0.48$	$5\left[\frac{X}{q} - 6\right]$	*Total annual variable cost—V*
2000	500	0	500
1800	445	3.3	448.3
1600	420	7.5	427.5
1400	370	13	383
1200	335	20	355
1000	302	30	332
800	278	45	323
600	268	70	338
400	298	120	418

Now let us examine the various elements of costs included in the model;

Set-up cost included :

direct wages
bonus paid
wastage per set-up
overheads

Manufacturing cost consisted of :

cost of material
direct wages
productivity bonus
machine running cost
factory overheads

Stockholding cost included :

interest on capital
salaries and wages of warehouse staff

rent, rates & taxes of warehouse
insurance charges.

We ask ourselves :

Can we do anything about the wages of the workers once we have decided to supply the product in question ?

Will it change, if the batch production quantities are altered?

Can we reduce the amount paid to workers if they are engaged for lesser time ?

Can we alter the salaries & wages of warehouse personnel if we change batch quantities ?

Can we alter in any way the rent, rates of warehouse by altering the production quantities ?

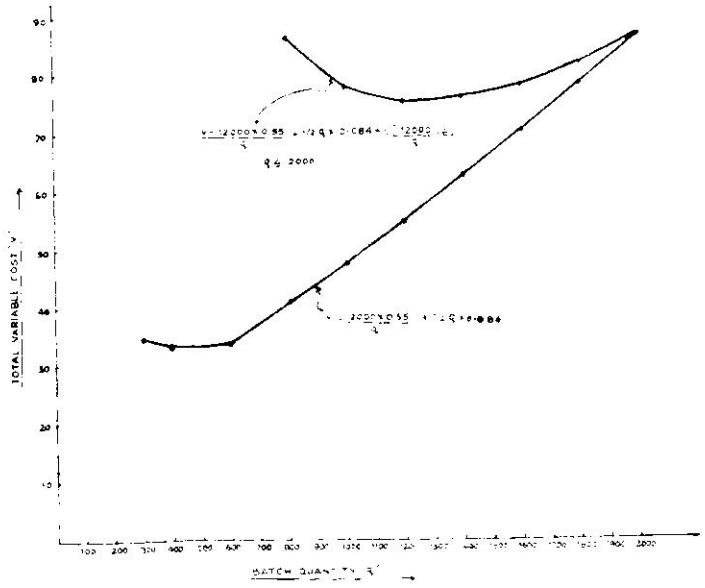
Can we influence the factory overheads by changing the production quantities ?

The answer to all such questions in most of the cases will be NO.

The following items are susceptible to be influenced by any change in policy.

Set-up cost :	Bonus paid to workers
	wastage in a set-up
Manufacturing cost :	Material cost
	machine running cost
	production bonus
Stock holding cost :	Interest on capital tied up as stocks
	insurance on stocks

These elements of costs are the only ones which can be varied by changing the batch quantity. Those costs, which can be influenced by a decision in question, are called variable costs. In the analysis fixed cost of the system should not be included, as nothing can be done about



On the other hand, when additional capacity can be obtained then there is considerable difference in the two policies. If the decision is to produce in batches of 800 units then our nominal savings are Rs. 177 (500—323) (see table I) but if this policy is implemented then our real annual cost is Rs. 86.5. Incidentally, it is the same as at q = 2000. Hence there is no saving.

In a case when additional resources (machines/workmen) are to be acquired in order to produce in economic batch quantities, then we must consider the fixed as well as variable costs for such acquisitions. Such acquisitions need to be justified against the savings made as a result of producing in optimum batch quantities.

Concluding remarks : In any inventory problem situation, fixed cost of the system contributes the largest share for the total cost. So greater effort must be directed at reducing the fixed cost of the system. It is always advisable to apply work study techniques for reducing the fixed cost of the system before any serious attempt is made to apply operational research techniques to inventory problems. Operational research techniques can help in reclaiming those savings which work study techniques fail to achieve.

Spares Inventory Control by Materials Management

K. Chandramouli

Materials Management plays an important role in modern management and is as important an aspect as the management of men, machines and money. The importance of Materials Management can be easily visualised by the fact that nearly 50-80% of the sales value is represented by material costs in many industries, thereby establishing a close relationship of material cost to the profit. Constant endeavours to exercise effective control on this major cost factor resulted in the new concept of Materials Management. The main objective of Materials Management is to bring down the material costs by improving the methods of acquisition, movement, inventory and handling of materials. To achieve this, Materials Management combines all the functions connected with materials and synchronises the activities of purchasing, handling, and inventorying of production materials. This unified approach is necessary because what may appear to be most efficient method for carrying out one function may result in substantially higher costs of another related function. This Materials Management brings together the various activities under a single responsibility instead of fragmentising them into separate responsible units as is done in conventional organisations.

As an integrated function, Materials Management includes all the activities of planning, scheduling, procuring, moving and controlling materials, components, sub-assemblies and supplies used in producing Company's products, including the shipment of goods. In brief, it develops material requirements, computes economic order quantities and establishes schedules of material delivery dates which will meet production needs. Also it maintains a price-quality relationship consistent with engineering, manufacturing and standard cost requirements. Another important function is the development of realistic material budgets for material costs and operations.

Present Situation In India

However, Indian entrepreneurs have not yet fully recognised the impor-

tance of Materials Management and have mostly accepted the conventional type of organisation with separate responsible units for various activities. The result, though not entirely due to this reason, is well known from the interesting facts and figures quoted below :

1. Twelfth census of Indian Manufacturers 1957 shows that inventories account for 90% or more of the working capital.

2. A Reserve Bank Survey (1963) of 1001 joint stock companies showed a total inventory of a little over Rs. 8,000 million.

The high inventory values, quoted above, comprise of raw materials, work in process, finished goods, equipment spares and operating supplies. The inventories in raw materials, WIP, and finished products could be depleted gradually by consumption over a period during which the procurements are reduced or completely avoided. Also they could be further controlled by better planning, scheduling and other effective measures. But it is extremely difficult to reduce the inventory which has been built up due to wrong selection of a variety of equipment, accumulation of unwanted security spares to a great extent and the surplus items built up in the construction stages of the project. Hence the reasons for high inventories due to spare parts and operating supplies are considered in detail here in preference to the high inventories due to raw materials etc.

1. Projects are carried out in different phases and stages by contractors supervised by departments, directly by departments and by consultants on turn-key basis. Also, there is bound to be a definite time lag between the various phases of the project. These factors naturally tend to the selection of similar equipment but with minor differences in capacity, specification and make. Multiplicity in the types of equipment necessitates keeping many spares, including insurance and security spares at a huge cost. The variety of equipment for similar operating conditions and the need of many spares, thereby blocking up a huge capital, could be avoided in close liaison wtth Materials Management.

A big plant is reported to have blocked up nearly Rs. 8 lakhs in inventory due to the following variety of similar equipment in its various sections.

a. Compressors of 100 CFM and 900 CFM from the same manufacturer.

b. Compressors of 1000 CFM from different manufacturers.

c. EOT cranes of 30T and 15T capacity from the same manufacturer, but with slight changes so that parts are not interchangeable.

d. Forklift trucks of 3T and 2T capacity from the same manufacturer.

e. Forklift trucks of 3 and 2T capacity from different manufacturers.

f. Electric hoists of 1T, 1½T, 2T and 3T capacity from three different manufacturers.

g. Variety in types of reduction units, elevators, conveyors, pumps, valves, etc.

The huge capital block up in spare parts for these variety of equipment could have been avoided with due importance to the functions of Materials Management in the early stages.

2. Project estimates usually allow for the purchase of 10% of the original value of equipment as spares. In trying to supply the 10% spares, the manufacturer is prone to push out whatever item he has in stock irrespective of the utility of the item. In many cases, very costly insurance or security spares are supplied by the manufacturer and these are accepted without utilising the statistical techniques available for determining the number of insurance units to be bought. Materials Management under similar circumstances could effectively lay down the broad principles and also the simple working rules for the procurement of spares.

3. Materials procured during the project stage for construction purposes are usually very much in excess of the actual requirement. The excess procurement is a result of many factors like high estimates, uncertainty in the availability and supply of material, uncertainty in the delivery schedules, inherent fear that shortage of material will delay the project etc. Therefore, when the construction phase is over usually there will be a big surplus of general hardware and other construction items. Failing to take immediate action in the surplus inventory which runs into millions of rupees in many cases, results in a huge block up of capital and loss of interest paid on capital. In many cases disposal of surplus stock is delayed by as much as 3 to 5 years. The interest on capital blocked up and other inventory carrying costs account for nearly 15% per annum of the inventory

value. Thus it would be economical to immediately dispose the surplus even at 60% of its original value instead of carrying it in stock for 3 to 4 years. This fact is usually overlooked in the conventional set up where no single section or department is accountable for the high material costs.

4. In the conventional organisation, the requirements of spare parts for different equipment are assessed by different area maintenance engineers. In a well spread out plant there are generally many area engineers with a number of equipment under their control. Each maintenance engineer assesses the spares requirements for the equipment under his control and does not consider similarity/identicality of spares for equipment in other areas. This area-isolated approach, irrespective of similar equipment and identical/interchangeable parts, leads to duplicate storing of many parts. An identical part stocked in more than one bin with different stock levels leads to duplicate work in procuring, handling, storing, inventorying and also results in higher inventory value than if stocked in one bin with one stock level. A unified approach for spare parts management of the entire plant under one responsible unit would result in identifying similar/identical/standard parts and grouping them together for the purposes of simplified procurement and storage. Such grouping of similar items could be usually carried out in the following category of spares : Bearings, V Belts, reduction units, transmission chains, motors, couplings, conveyor and elevator beltings, air cylinders, hydraulic cylinders, solenoid valves, electrical switches, fuses, cables, light fittings, hardware items, etc. It is estimated that nearly 12 to 18% of the total bin items for spares could be reduced by grouping such similar/standard parts.

What Materials Management Can Do to Avoid High Inventory of Spares

As stated earlier, there can be very little reduction if inventory is accumulated because of a variety of equipment for similar operating conditions, excess stocking of insurance and security spares, and surplus stores items left over from construction. Such inventories have to be avoided even before accumulation and it is not possible to effectively avoid such high inventories in the conventional set up of purchase, stores and

project activities where no single unit is responsible for the high inventories. Project personnel, with their main aim of completing the project on schedule within stipulated budgets, do not lay particular stress on the reduction in variety and supplies of equipment. Similarly, their attention will be more towards the commissioning and erection of equipment rather than on the procurement of necessary spares in their required quantity. Even if maintenance engineers are involved in the ordering of initial spares there will be a tendency to overstock items with the aim of safeguarding the interests of the maintenance section. Under this state of affairs in the conventional set up, purchase and stores sections are just passive coordinators in procuring and storing high inventory in spares. In this context, the unified approach of Materials Management, with its association at the equipment selection stage, can be of great help in reducing the inventories of spares.

Utility Value and Interchangeability of Spares

The high inventories accumulated due to slow-moving items, insurance spares and due to the variety in the types of equipment cannot be usually reduced or wiped out and the necessary inventory cost will have to be absorbed in the overall material costs. The percentage of extra inventory costs to the total cost of equipment remains high under such circumstances. However, any plans for expansion of the plant open up a new opportunity for reducing the percentage of inventory costs to the overall cost of the equipment. This could be achieved by : (a) increasing the utility value of slow-moving and insurance spares (b) increasing the interchangeability of spares.

Utility value of slow-moving and insurance spares can be defined as the initial cost of the equipment supported by a given value of these spares. In other words,

$$\text{Utility value} = \frac{\text{Original Cost of the equipment}}{\text{Value of slow-moving \& insurance spares for the equipment}}$$

Thus, if the cost of the equipment is Rs. 20,000/- and the value of slow-moving and insurance spares is Rs. 2,000/-, then these spares support 10 times their value of the equipment and, therefore, their utility value is 10. Once the slow-moving and insurance spares have been acquired,

the utility value can be increased only by adding more equipment during the expansion without correspondingly increasing the value of slow-moving and insurance spares.

Interchangeability of parts can be increased if there are a number of similar/identical equipment which require the same spares. In other words, lower the variety or type of equipment, higher is the interchangeability of spares. Variety value of equipment can be defined as the ratio of types of equipment to the total number of equipment in the Plant.

$$\text{Variety value} = \frac{\text{Types of Eqpt. from interchangeability concept}}{\text{Total number of equipment in the plant}}$$

Functionally, a centrifugal pump and an overhead crane can each be considered as a separate type of equipment. But from the interchangeability concept, under a centrifugal pump there might be one or more sizes/types/makes, each making a separate variety or type of equipment. Interchangeability of spares will be increased when more number of equipment of the same type are added so that the variety value is decreased. Such interchangeability of parts, especially among high consumption or fast-moving spares will result in less number of bin items, better procurement at lower costs, lower buffer stocks and overall lower inventory value of spares in stock.

Measures to Increase Utility Value of Spares

Any plant expansion with scope to add more equipment to the existing facilities can be advantageously utilised to increase the utility value and interchangeability of spares. This advantage leading to effective inventory control can be gained by giving due consideration to the following points during plant expansions, addition of equipment and replacement of old equipment.

(a) As far as possible and unless there is a definite technical reason for a change, the model, type, capacity and make of the new equiptment should be the same as the already installed equipment.

(b) Many times technical changes to overcome operational or maintenance difficulties need be carried out on only certain parts of the whole

equipment, leaving the other sub-assemblies practically the same as in the original model.

(c) In many cases the equipment manufacturers would have stopped the manufacture of old models and will come out with so called 'new and better models'. In India this type of technological obsolescence within a space of 5-8 years will not be to any appreciable extent, and it is perhaps economical to go in for the old model, unless there is specific and quantifiable advantage in purchasing new model. The usual tendency to purchase any new equipment on the pretext of technical changes or improved models will have to be properly balanced with an overall idea of the economics of the initial cost, operating maintenance cost and inventory or material costs.

(d) Variety of equipment is introduced not only because of the differences in the capacity and model of the equipment but also because of the change-over to a different manufacturer. Two equipment of same capacity and for absolutely similar operating conditions, but purchased from two different manufacturers, necessitate the stocking of spares separately as no two parts will be generally interchangeable in these equipment from different manufacturers. Purchase of any new make of equipment, not already tried in the plant, should not be decided merely on the initial lower purchase value of the equipment. Other important factors like design and technical superiority, operational and maintenance needs, and also the inventory costs involved should be considered before the selection of a new make of equipment. Since operational and maintenance needs and the problems involved cannot be visualised before field trials in many cases, and assuming the design features to be not far superior, the main consideration in such purchases should be the additional inventory costs. This factor is usually overlooked while purchasing new equipment during plant expansions.

Thus Materials Management not only aims at avoiding the excess accumulation of spares inventory but also attempts at increasing the utility value and interchangeability of spares so that there is effective spares inventory control. Other inventory control techniques are not dealt here for the simple reason that even without the unified approach of Materials Management, an organisation could initiate these measures, though they will be effective to a lesser extent than under Materials Management.

Work in Progress : Investment and Its Control

G. D. Sardana

Work In Progress is goods in the process of manufacture from the time they are taken out from stock as raw materials till they are again returned to stock as finished materials.

WIP investment represents an equal percentage of the total inventory consisting of Raw Materials, Finished Goods and Work In Progress. Besides representing a blocked up capital on shops, on and before various processing centres, a high WIP can pose problems of production control —specially of not meeting the schedules of completion.

An evaluation of WIP investment, laying of norms and procedures for its control is, therefore, an important production management function. An attempt is made in this paper to analyse these problems with the help of actual case studies.

Origin of WIP : Production, mainly classified into three categories called the Flow production, Batch production and Jobbing production, have one underlying principle of converting the existing stock into different forms of stock. Hence, the Work In Progress calls for value addition to the original form of the stock withdrawn.

The stock withdrawn originally at time T_1 with base material value R_1, would change to a value R_2 at time T_2, the difference arising because of value addition during the time interval $T_2—T_1$. The value goes on rising till the stock reaches the finished state and stored, where its value would be highest. The value added is not necessarily directly proportional to time it spends during processing stage. It can be more in the initial stages and rise slowly with increase in time. Conversely, it can rise slowly in the initial stages and may have a rapid rise later.

At times, the stock remains on the shop without any value addition to it. It is possible that the stock may have been in a queue before a processing centre or may be there because of improper production planning.

The WIP investment in such a case would be the value of the material. This is the crux of Work In Progress.

Factors Influencing WIP Investment

A. (i) In Jobbing production, the production process is confined to carrying out the processing of manufacture by operators in small quantities covering a large number of processes. Most of the jobs to be processed in this type are tailormade. Small quantities of Job Orders lead to lesser WIP investment. Further, WIP investment is also less because queues (of work awaiting for processing), can be controlled through diversion of such jobs to other operators. This may call for hiring of new operators for temporary loads.

By the very nature of the type of production process, the time required to process work through all its stages, is regulated more by long process time than by queueing time.

(ii) In flow line production, the work 'flows' through series of work centres, in practically the same sequence. The flow is not random but is systematically organised and planned to keep the series of work centres in full running. The proceeding and following cost centre to a particular cost centre are kept equally occupied so as to create a balanced rate of production. In such a type of production, the queueing of jobs between the cost centres is controlled and reduced to desired limits.

Thus in a flow type of production, WIP content gets proportionately related to the actual throughput cycle time of the job and is less effected by queue lengths. Quantitywise, though WIP in this type of production is high, it is because of the nature of production.

(iii) Batch production envisages the manufacturing work to be carried out in batches—the batches are determined so as to balance the cost of setting the machine, i.e., tool set up costs and the costs of carrying the inventory. Again the sequence of process operations called for is generally not the same for all. The

processing operations of the different batches are unrelated and unlike. This gives rise to a situation; where the jobs may come up in random quantities from random processing centres resulting in a queue. The length of the queue so formed is again random. The WIP investment in this type of production, would be highest, because of : (a) Quantum of work in actual processing, (b) Quantum of work waiting in Queues, (c) Throughput cycle of work in actual process, (Longer the throughput cycle, the longer the WIP investment stays on the shop), and (d) Waiting time inherent in queue (Longer the waiting time, the longer the WIP investment gets tied up on the shop).

B. Urgent/Rush Jobs tend to interrupt the flow of production and cause the throughput cycle of preplanned jobs lengthened. Meanwhile, the WIP investment pertaining to original job is retained on the shop.

C. Change of priorities and manufacturing programme on the shop have direct bearing on WIP investment. The jobs delayed owing to priority jobs remain on the shop because of their not getting moved to stock or to the next processing centre. They merely add up to WIP investment.

D. Down times could be for reasons of maintenance, breakdown, operator absenteeism, tool breakdown or non-availability of replacement tools in the event of a breakdown. The result is that they lead to queues in waiting and many a time splitting of jobs entails double the machine tool set up times. The consequence is a higher WIP content.

E. A faulty production planning system can get reflected in the form of : (a) Available queues before processing centres because of improper scheduling on various processing centres and defective sequences of operations ; (b) Unjustifiable higher batch quantities ; (c) Wrong selection of process centres/tools.

Controlling WIP Investment

It has been seen that WIP investment exists basically because of :

(a) Quantity in the batch, (b) Throughput cycle (Process cycle), and (c) Queueing time—all pertaining to work actually in process and work waiting in a queue at a particular time. The control of WIP investment should, therefore, be studied in the light of these factors.

(a) The selection of batch quantity, process sequence and selection of machines is based on the principles of production planning. In addition, it strikes a balance of costs involved in the stock-out probabilities and customer services. A high degree of service or a low stock-out probability shall entail covering high batch quantities on an order.

Principles of Inventory Management do suggest a solution to these types of problems. Low batch sizes on 'A' class items (high usage items) not only bring down the total investment (and hence the WIP investment) but also bring down the throughput cycles to further reduce WIP investment, whereas high batch quantities on 'C' class items (low usage items) do not necessarily increase the WIP investment. This is so, because of the low valued material content in them.

(b) The batch quantities having been scientifically arrived at, the next important step is to see that number of batches (or number of jobs are) also controlled on shops.

The overall manufacturing capacity of the shop and the related processing centres which are to be used for loading of the jobs should be clearly established and known in recognisable units. Jobs scheduled in excess to these should, therefore, be avoided to be routed to the processing centres. The excess of job orders sent over and above the established capacity are straightaway reflected in the form of a queue before the processing centre, thus accounting for WIP investment.

For an effective and substantial control on WIP investment, it is, therefore, necessary to analyse in a systematic manner, the load waiting on each processing centre with the capacity of the processing centre. The extra load over and above

the established capacity of a processing centre has to be directed to other processing centres with deficient work load, running of overtime/extra shifts and sub-contracting with due analysis on costs of each of the alternatives. Process cycle can be reduced through :

(i) Selection of best sequencing cycle and a better processing method including machine and tool selection. It may be necessary sometimes to subcontract an item outside for only reducing the throughput cycle and the queueing attached to it.

(ii) Gearing up the process technology and keeping in readiness all the tools so that a running batch is not split up. A running batch so split causes a vicious cycle of entailing double the tool set up on all the following processing centres.

(c) *Queue control* : However, one of the most important methods of controlling and restricting the WIP investment lies in determining and reducing the queues before processing centres. The queues cannot be eliminated to zero. Queueing helps to keep the process centre's utilization high. Before the actual process starts on a machine, preproduction planning activities like material check, tool scrutiny, methods analysis etc. are essential activities to be gone through. Also alternate jobs have to be kept ready for processing near a machine in order to cater to exigencies of off-loading the job already in process because of reasons like tools breakdown, non-availability of a second tool etc. The emphasis is, therefore, on reducing the queues. The queue lengths before the process centres have to be seen to realize their undesirable existence. As the queue times form a part of the throughput cycle, the exercise, therefore, first lies in attempting to know the lengths of the throughput cycles and thereby the queue lengths.

An actual case study is illustrated below to show how to determine the throughput cycle.

A total of over 500 job orders completed over of the last three months

in a shop of about 30 processing centres were gone through and data compiled as under :

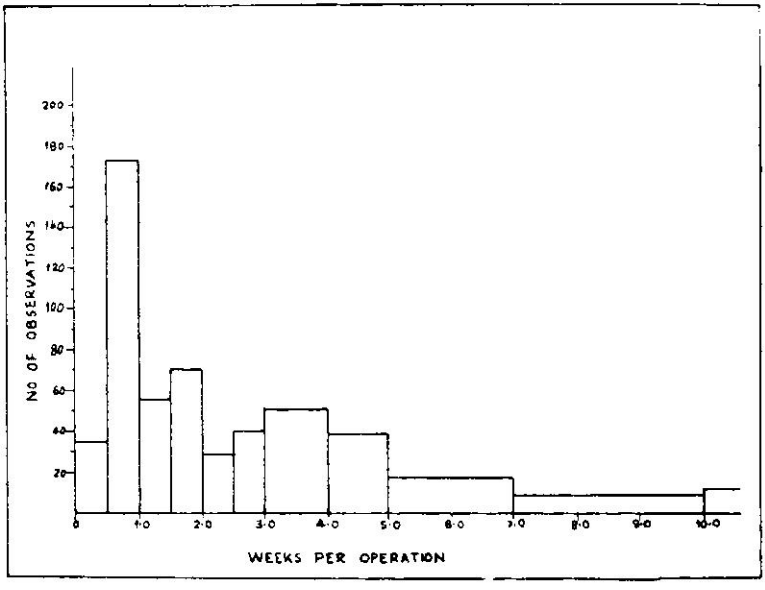
Duration (weeks operation)	*No. of (Job) readings*	*Total weeks in operations*
0.5	35	17.5
1.0	174	174.0
1.5	48	72.0
2.0	68	136.0
2.5	25	62.5
3.0	39	117.0
3.5—4.0	46	172.5
4.5—5.0	37	176.0
5.5—7.0	16	100.0
7.5—10.0	7	61.0
above 10.0	11	132.0
Total ...	506	1220.5

Thus, cumulatively,

1. 7% of the observations showed 0.5 weeks/operation.
2. 40% of the observations showed up to 1.0 week/operation.
3. 51% of the observations showed up to 1.5 ,,
4. 65% of the observations showed up to 2.0 ,,
5. 69% of the observations showed up to 2.5 ,,
6. 77% of the observations showed up to 3.0 ,,
7. 87% of the observations showed up to 4.0 ,,
8. 94% of the observations showed up to 5.0 ,,

The frequency distribution of the observations is shown in fig. 1.

Fig. 1

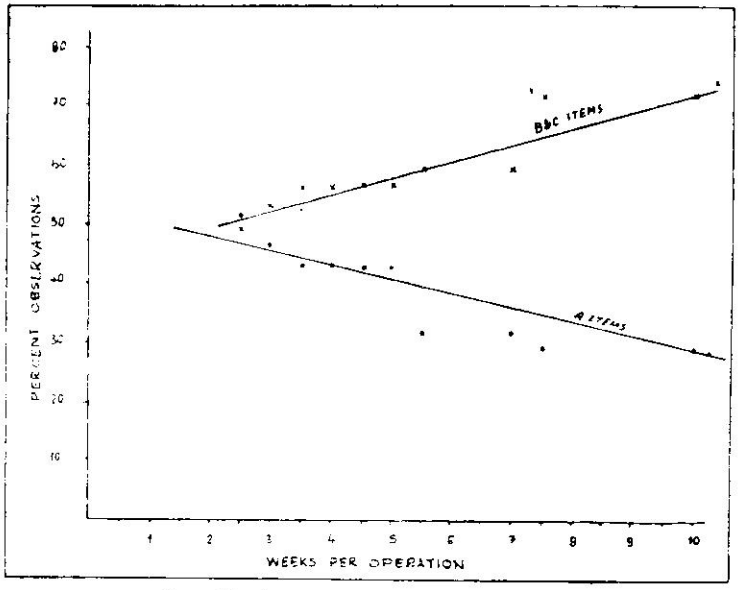


1) The analysis showed that the average time an operation stayed on shop during 'process' and queued before the actual process, came to 2.41 weeks. A further analysis showed that the actual process time on an average came to 1.1 weeks. Thus each job waited an average of 2.41—1.1= 1.31 weeks in a queue before a processing centre before the start of the actual manufacturing process.

2) Items with longer throughput cycle (than the average cycle) were further analysed and data re-arranged with reference to ABC classification of items.

Duration Weeks/Operation	*Total Items*	*No. of 'A' Items*	*Percent of 'A' Items to Total*	*No. of B & C Items*	*Percent of B & C Items to total*
2.5	25	13	51.0	12	49.0
3.0	39	18	46.2	21	53.8
3.5—4.0	46	20	43.5	26	56 5
4.5—5.0	37	16	43.3	21	56.7
5.5—7.0	16	5	31.2	11	68.8
7.5—10.0	7	2	28 6	5	71.4
Above 10.0	11	3	27.2	8	72.8
Total	181	77		104	

Fig. 2



Graphical representation of operation

3) It would thus be very clear that the more effective control lies in keeping a steady watch on 'A' class items. These items are contributing to WIP investment in a more pronounced manner. Firstly, they have inherent in them a high value of materials. Secondly, because they have been observed to stay longer on shops, they are allowing the WIP investment to stay longer on the shops.

The analysis, should, however, not appear to be very surprising. It is true that 'A' class items, i. e. items with high usage values are also the items demanding a high manufacturing cycle and hence a high throughput cycle.

Norms for WIP Investment

For a proper control on WIP investment, it is not only necessary to analyse the factors responsible for it, as illustrated in a case study above, but it is also equally essential that a proper working procedure is evolved which measures the WIP investment in a sort of continuous feedback. This will in turn help to devise means, many a time peculiar to the unit under study, to take steps in order to minimise WIP investment.

One of the better means of checking the effectiveness of controls on reducing WIP investments is to establish indices or base values to which WIP investments observed at various periods of time can be compared.

Some of the important ratios of comparison are :

1) WIP Investment/Total Inventory
2) WIP Investment/Total Turnover
3) WIP Investment/Total Turnover less material costs (i.e. value added)
4) Average throughput cycle per operation
5) Average throughput cycle per Job Order operation of 'A' Class items
6) Value of Input Jobs/Value of Output Jobs (over the same time base)
7) WIP Investment/Processing Centre Capacity

First ratio establishes relationship to the total inventory consisting of finished, semi-finished and WIP content. A high ratio could be interpreted as a reflection on high throughput cycles, unbalancing of shop loading or lack of co-ordination in input control of job orders to various processing centres.

This interpretation can however be affirmed with other ratios like average throughput cycle per operation and value of Input Jobs/Value of Output Jobs. Ratio, average throughput cycle per Job Order operation of 'A' class items is to analyse more in detail the occurrence of high average throughput cycle per operation. Second and the third ratios show the correlation WIP investments carry to the turnover with and without value added contribution.

The ratio of WIP investment to processing centre capacity is the WIP investment in money value existing per machine-hour utilized. This is an important relationship as the WIP investment levels can be varied with wide margins by increasing or decreasing the machine use. *Corke suggests setting norms of standard levels of WIP investment for comparison with actual values of WIP investment.

* Corke D. K., "Production Control is Management", 1969, Edwin Arnold (Publishers) Ltd., London.

If,

M = value of one week's material Input ; F = value of one week's material Output ; W = weighted average throughput time a batch is in progress, in weeks ; L = one week's wage bill, and O = a week's overhead

then, Standard level of WIP $= W\left(\frac{M+F}{2}\right)$, or

$$= W\left(M+\frac{L+O}{2}\right)$$

To determine W, the weighted average time a batch is in progress in shop in weeks, total finished jobs in the shop over a period of N weeks are analysed as under :

If, $m_1, m_2, m_3 \ldots$ = material content of each separate batch in monetary terms

$l_1, l_2, l_3 \ldots$ = loaded labour values (including overheads) of each separate batch

$w_1, w_2, w_3 \ldots$ = number of weeks which each separate batch ought to take to complete in accordance with standard

then the WIP Investment shall be given by :

$$w_1\left(m_1+\frac{l_1}{2}\right) + w_2\left(m_2+\frac{l_2}{2}\right) + w_3\left(m_3+\frac{l_3}{3}\right) + \text{------}$$

$$= \Sigma W\left(m+\frac{l}{2}\right)$$

Therefore, $N \times W\left(M+\frac{L-O}{2}\right) = \Sigma W\left(m+\frac{l}{2}\right)$

or, $$W = \frac{\Sigma W\left(m+\frac{l}{2}\right)}{N\left(M+\frac{L+O}{2}\right)}$$

The weighted average value of W so obtained can be used to obtain the standard level of WIP investment as

$$WIP = W\left(\frac{M+F}{2}\right) = W\left(M + \frac{L+O}{2}\right)$$

This, as stressed earlier, shall be relevant to the peculiar characteristics of the shop or the group of processing centres under review. One of the important considerations is that the mix of the products (the batch order quantity determining criteria) remain unchanged. Also, the utilization factor of the processing centre be kept at the same level. This is obvious as WIP investment can be deceptively reduced by bringing down the utilization factor of the processing centre.

Keeping in mind the Standard Level of WIP so obtained, actual levels of WIP can be correlated and indices obtained over various periods be compared.

Thus, let standard level of $WIP = K_o$

Actual WIP at time $t_1, t_2, t_3 \ldots = k_1, k_2, k_3 \ldots$

then, I_1, the WIP index (relative) at time t_1

$$= \frac{K_1}{K_o} \times 100 \text{ and}$$

I_2, the WIP index (relative) at time t_2

$$= \frac{K_2}{K_o} \times 100, \text{ and so on.}$$

A decreasing index with time should be a reflection of good measures introduced to control WIP investment.

Alternatively, a WIP Index (Relative) can be fixed as a target to be achieved.

Capacity Utilisation in Public Enterprises

R.K. Mishra

The public sector constitutes the core of planned economic development in India. Any shortfall in the production performance of public sector undertakings becomes critical, since it has a cue reaction on the industrial sector as a whole. The purpose of this study is to point out the extent of capacity utilisation in public enterprises and the impact thereof, causes of the under-utilisation of the capacity created, and suggestions to remedy such a state of affairs.

Extent of Capacity Utilisation in Public Enterprises and the Impact thereof

The extent of capacity utilisation has been very low in public enterprises. The Minister of State for Finance, replying to a question in the Lok Sabha on August 25, 1969, had informed the Parliament that only 50 per cent of the capacity created was being utilised in the public sector. Recently, the Pathak Committee (appointed by the Planning Commission to look into the working of the public sector undertakings) Report further endorsed this statement and it identified the problem of the under-utilisation of the capacity created as the most important problem being faced by public enterprises in India today.

The extent of capacity utilisation can be judged from the statistics presented in Table 1 with regard to the utilisation of capacity in selected public undertakings.

Table 1 shows that in all the selected public undertakings (representing about 50 per cent of the total investment in the Industrial and Commercial concerns of the Central Government) there were large unutilised capacities. It is important to note that capacities remained unutilised even in the field of heavy industry on the production of which depends

TABLE 1

Percentage Utilisation of Installed Capacity in the Public Enterprises

Sl. No.	Name of Undertakings	1966 —67	1967 —68	1968 —69	1969 —70	1970 —71	1971 —72
1.	Hindustan Steel Limited						
	Steel (a) Bhilai	74	71	69	74	77	78
	(b) Rourkela	42	51	64	61	58	46
	(c) Durgapur	59	46	51	51	38	44
2.	National Coal Development Corporation Limited—All Types of Coal	58	61	74	81	80	84
3.	Fertilizer Corporation of India Limited						
	(a) Sindri Unit : Ammonium Sulphate	88	68	75	82	77	65
	Double Salt	49	50	40	36	35	26
	Urea	79	69	66	67	65	60
	(b) Nangal Unit : CAN (46% N)	90	92	98	101	70	70
	Heavy	67	79	101	113	63	86
	(c) Trombay Unit : Urea (46% N)	54	58	69	58	64	60
	Complex Fertilizers	24	35	60	62	76	107
	Methanol	—	32	50	43	—	70
	(d) Namrup Unit : Ammonium Sulphate	—	—	72	66	63	73
	Urea	—	—	43	48	56	55
	(e) Gorakhpur Unit : Urea (46% N)	—	—	64	91	85	95
4.	Heavy Electricals (India) Ltd.						
	(a) Switch gear, Control gear and Industrial Rectifiers	92	50	38	35	53	81
	(b) Transformer	80	43	55	52	72	76
	(c) Capacitor	85	65	70	41	91	78
	(d) Industrial Motors	45	21	28	32	40	70
5.	National Mineral Development Corp. Ltd.—Lump ore	31	32	67	70	80	—
6.	Neyveli Lignite Corp. Ltd.						
	(a) Lignite	55	76	89	95	—	—
	(b) Power	48	69	59	52	—	—
	(c) Urea	40	47	59	60	—	—
	(d) Leco	14	27	39	44	—	—
7.	Hindustan Photofilms Mfg. Co, Ltd.						
	(a) Cine-Positive & Dia Positive	—	39	42	66	—	—
	(b) Photographic Paper	—	5	6	9	—	—
	(c) Medial X-ray	—	23	17	35	—	—
	(d) Cine-film sound	—	—	—	17	—	—
	(e) 35 mm. negative film	—	—	—	6	—	—
	(f) Roll film	—	—	—	Negligible	—	—
8.	Heavy Engineering Corp. Ltd.						
	(a) Mechanical Items	8	8	11	17	—	—
	(b) Structurals	30	32	22	15	—	—
	(c) Castings & Forgings	28	50	Not available	61	—	—
	(d) Machine Tools	Not available	11	Not available	18	—	—

Source : Annual Reports of Selected Public Undertakings for the year 1966-67 to 1971-72.

the economic advancement of the country. It is worth mentioning that our import bill for fertilisers and steel would have declined considerably, had the public industrial undertakings in these branches exploited their capacities to the full.

Theoretically, the repercussions of the underutilisation of capacity in the public sector concerns can be evaluated in micro and macro terms. In micro term, the underutilisation of the capacity turns the working results of public enterprises into the red. It is because the break-even points of the public sector units rest on a very high level, i.e., the profit can be earned at a level of production falling in very close to the rated capacity. In macro term, the low or no profitability of public enterprises, resulting from the lack of capacity utilisation, prevents the socialist industrialisation on which depends the hopes of the success of schemes concerning the rapid economic development of the country. According to the Fourth Five Year Plan's Draft Outline : "The original expectation of an expanding public sector yielding, in due course, substantial resources for its continued development have not been realised. The resource position has not improved and with the existing constraints only limited increase in public industrial activity has been proposed in the plan. The outlay of Rs. 2910 crores on industries and minerals in the Central sector form 12 per cent of the total Fourth Plan outlay of Rs. 24938 crores and 20 per cent of the outlay of Rs. 14397 crores in public sector. Sectoral break up reveals that outlays on new schemes are a very small proportion and the accent is on completion of the schemes which are already in the hands. New outlays on schemes on mines and metals are just under 2 per cent, fertilisers and pesticides 1 per cent and those on machines and engineering, just 0.2 per cent of the total plan outlay."[1]

Causes of the Underutilisation of the Capacity Created

The underutilisation of capacity in the public sector enterprises has been the mix of large variety of factors. The study of the selected public enterprises, in this relation, has brought to the fore broadly the following reasons responsible for this phenomenon :

1. Planning Commission (Government of India, New Delhi), Fourth Five Year Plan—1969-74 Draft, pp. 229-266.

(i) Provision of initially a heavy in-built capacity

(ii) Recession in the demand for industrial products

(iii) Operational difficulties and administrative inefficiencies

Heavy In-Built Capacity : The provision of a heavy in-built capacity in public undertakings has led to the underutilisation of the same. Such in-built capacities were planned at the Government level which while providing them had a long-term view of the economy in her consideration. There is no reason to disagree with the fact that it is cheaper and more efficient to expand the existing plant rather than set up an altogether new one. It should, however, be admitted that the achievement of full capacity is a factor which is achieved through stages but the growth of public enterprises shows that Government ordered for the expansion when the capacity installed had not been achieved. For example, the expansion programmes in the case of million tonne steel plants started well before they had achieved their rated capacity and simultaneously the expansion of coal washeries was taking place with the fact in ultimate knowledge that they had never achieved the rated capacities. On the other hand, the Fertiliser Corporation of India and National Coal Development Corporation have respectively gone for setting-up new factories and new collieries in spite of having not utilised the full rated capacities of production. The Heavy Electricals (India) Limited, Bhopal, presents an interesting case in point. Originally the factory was taken up to produce heavy electrical equipments worth Rs. 12.50 crores but, later on, as per the Governments wishes this limit was extended to Rs. 25 crores. In April 1966, when the construction of the factory was in progress, the Government approved of a further extension of this limit to Rs. 58.48 crores.

The above has led the Study Team on Public Sector Undertakings to remark : "The present procedure for assessing demand through ad hoc or standing working groups in the Planning Commission may be useful for determining plan priorities, or a national allocation of resources for different projects, it is certainly not good enough for an investment decision and hence it is recommended that before going for additional capacity the agency concerned should assess the demand for product in all its aspects, the effect of price on demand, the allocation pattern, the time phasing of demand and the practical possibilities of selling the

product under competitive conditions in India and abroad."[2]

Recession : The recession in the demand for industrial products had mainly contributed to the underutilisation of capacity in public enterprises during 1966-68. According to the 14th Annual Report of Hindustan Steel Limited : "The underutilisation of capacity was partly responsible to recession. In the wake of recession, domestic demand for steel had started to fall after 1964-65. The economic conditions during 1967-68 were such as to cause a further decline in the internal steel demand."[3] One reason for this reduction was the slowing down of capital formation. The development outlays in the public sector had to be restrained in view of Government's budgetary situation as well as the paramount need to contain inflation. As a result, the plan outlay during 1967-68 had to be maintained at about the same level as 1966-67, which was itself lower than the outlay achieved during 1965-66, the last year of the Third Five-Year Plan. The overall rate of investment in the economy as a proportion of national income fell from 13/14 per cent in 1964 to about 11/12 per cent in 1967-68.

The second reason for the decline of demand which affected the production capacity of the public sector plants adversely, was the relative stagnation in industrial production. Despite favourable seasonal conditions and a marked improvement in the agricultural situation, the rate of growth of industrial production continued to decline. Against an annual increase of 8 per cent during the period 1961-67, the rate of growth diminished progressively from 5.6 per cent in 1965 to 2.6 per cent in 1966 and 1.4 per cent in 1967. Amongst the different industrial sectors, steel-using industries suffered the maximum decline, causing a fall in their off-take of steel. The total home supply of fabricated steel, which is a good index of internal demand, declined from 5.36 million tonnes in 1964-65 to 5.2 million tonnes in 1965-66, 4.7 million tonnes in 1966-67 and 4.1/4.2 million tonnes in 1967-68. Thus, in 1967-68, the domestic steel demand, if anything, was slightly lower than the demand at the end of the Second Five-Year Plan.

Operational Difficulties and Administrative Inefficiencies : The operational difficulties like shortage of stocks and spares, breakdowns of plant and

2. Administrative Reforms Commission (Government of India, New Delhi), Study Team's Report on Public Sector Undertakings, June 1967, p. 91.
3. Hindustan Steel Limited (Ranchi), 14th Annual Report, 1967-68, p. 2.

machinery, failure or shortage of electricity supply, labour trouble and absenteeism, and administrative inefficiencies significantly contributed to the lack of capacity utilisation in public enterprises.

The transformer, capacitor, switchgear and industrial motors fabrication departments of Heavy Electricals (India) Limited have been under-producing because the concern has run short of required skill, indigenous raw material, and supplies of materials and components. Besides this, frequent labour trouble, absenteeism and tool-down strikes have also been causing a fall in the production. The administrative slackness, too, has arrested the growth of production in the enterprise. For example, though some factory blocks had been constructed and commissioned ahead of schedule, more than 9 months were lost in ordering machine tools and raw materials due to delay in operating the Purchasing Agency Agreement. Consequently, there was no production worth the name in 1960-61, though the factory had been formally commissioned in July 1960. A complete reliance on the foreign suppliers has resulted in this case in lowering down production as they have not been able to fulfil the contracts in this regard as per the supply schedules agreed upon. Besides, a very high administrative lead time in the purchase and a very low labour productivity in the concern, as pointed out by its consultants, has further helped in the deterioration of capacity utilisation.[4]

The shortage of power and frequent interruptions in power supply have severely influenced the capacity utilisation in public enterprises. The Committee for Public Undertakings in its 44th Report on Fertilisers and Chemicals Travancore Limited says : "Although the plants expected under the Third State Expansion Programme were completed in 1965, these could not be commissioned for a long time due to severe power shortage. In fact, even the plants erected under the Second Stage Expansion also operated much below the rated capacity due to power shortage, power interruptions etc. After full power supply was resumed in June 1966, the trial runs of the plants were commercially commissioned as from October 15, 1966. Thus these plants worked for full year only during 1967-68. This was also the year when there was no cut. But the actual production during 1967-68 was only between 50 to 60 per cent.

4. Committee on Public Undertakings (1967-68), Twelfth Report (Fourth Lok Sabha) on Heavy Electricals (India) Limited, Lok Sabha Secretariat, New Delhi, April 1968, pp. 43, 60, 67 and 70.

This was because there were 112 power interruptions/voltage drops."[5]

The non-achievement of the targeted capacity in Hindustan Steel, besides recession in the demand for industrial products, has largely been the result of low productivity per worker, high absenteeism, lock-outs, and shortage of stores and spares etc. The Solveen Commission which had been appointed to suggest the measures for stepping up the efficiency of the three steel plants under the management of Hindustan Steel Limited, was very much depressed with the percentage of absenteeism in its Rourkela unit. To quote it : "The abnormally high percentage of absenteeism which, according to data of Energy and Economy department, temporarily reached 20 to 25 per cent of full strength in important departments is disquieting. Such conditions are not apt to secure a continuous smelting mill operation and call for a review of shop regulations and personnel policy."[6] The unsocialistic attitude of labour toward work is on the spread in the concern. In Durgapur Steel Plant alone, as many as 66 *gheraos* occurred during April-June 1969, and only in May, 1969, about 10,000 man-hours had been lost due to indiscipline.

Suggestions to Improve Capacity Utilisation

The study of the causes of the underutilisation of capacity in public enterprises has revealed that it has been the interaction of such factors for which the Government, the managements of public enterprises and the workers in public sector may be held responsible. Thus suitable measures will have to be taken at the Government, public enterprises' and the workers' levels to do away with this problem.

The Government is suggested to create realistic capacities for public enterprises which is possible only through a realistic estimation of demands for their products. To have a realistic estimate of demand for a public enterprise, the Government should create first a management team which should be, later on, made responsible for the management of the enterprise. This team should make an independent

5. Committee on Public Undertakings (1967-68), Fifty-Fourth Report (Fourth Lok Sabha) on "Fertilisers and Chemicals Travancore Limited", April 1969, pp. 11-12.
6. Committee on Public Undertakings (Third Lok Sabha), Eleventh Report on "Rourkela Steel Plant of Hindustan Steel Limited", May 1965, p. 24.

assessment of the Country's demand for its products and this exercise should be repeated periodically taking note of changes in demand caused by switchover to alternative products, technology or even sources of the energy. Next, the Government should liberalise considerably procedures of issue of an import licence and grant of foreign exchange. Alternatively, it may give incentives for the indigenous production of the required goods. Finally, the Government should discourage private competition to grow in such sectors in which the public industrial installed capacities are dormant. Though private competition is an incentive for stepping-up efficiency in public enterprises, but it will act against the fuller utilisation of capacities created in them as the profit element in the prices of their goods would be lower in comparison to private enterprises on account of a relatively higher capital block.

At the public enterprises' level, measures with regard to diversification of production, promotion of product exports, improvement in the interrelations and toning-up of administration will have to be undertaken. The diversification of production should mean both the manufacture of new products by modifying, postponing and avoiding altogether new investments or taking-up job orders and thus achieving the targeted capacity through existing capital block with minor modifications.

The schemes of promoting product-exports from public enterprises is likely to lead to a better utilisation of industrial capacities in public enterprises. For this, a survey of the world demand for industrial goods may be made. This can be done by the Bureau of Public Enterprises. The Bureau (after having made the survey and calculated the prospects of Indian exports), in its turn, may indicate to different public enterprises their export potentials and the export markets for their products. The Government should make every effort to provide necessary finance and raw material facilities to the exporting public enterprises. Some of the public enterprises (Hindustan Steel Limited, Hindustan Machine Tools, Indian Telephone Industries and Heavy Electricals India Limited) have taken resort to this measure very well for improving the capacity utilisation therein.

The Ministry of Finance in its Memorandum on Public Sector[7] Enterprises

7. See : *Lok Udyog*, Vol. II ; No. 12, March 1969, New Delhi ; p. 1288.

(submitted to Parliament along with Budgetary Papers in February 1969) felt that an important measure for the utilisation of idle capacity depends on the coordination developed by public enterprises with each other. This coordination can be developed in the fields of (i) making purchases, (ii) supplying stores and spares, (iii) providing technical know-how, (iv) imparting training to personnel of different cadres, and (v) seizing-up orders by forming consortiums.

On the administrative side, public enterprises will have to accelerate their managerial excellence. The long lead-time (administrative) in purchases must be brought down to the normal limits and an adequate supply of stores and spares should be maintained. For this, a careful determination of the minimum, maximum and safety stocks of stores and spares should be a *must* in all public enterprises. For preventing plant break-downs and hold-ups, public enterprises should strengthen their plant level management. Besides, only such machinery should be purchased by public undertakings which is not old or used.

Lastly, it is suggested to consider the labour policies of public enterprises all afresh. Whereas the justified and right demands of the labour should be immediately acceded to, their unsocialistic attitude toward work must be strongly met with.

Conclusions

The primary goal of the Indian Economy is to develop rapidly. This is possible only through the complete socialisation of the production apparatus of the country. The hopes of the complete socialisation of the production apparatus and its efficient functioning rest on such a public sector which expands continuously at a very rapid rate with finances gathered for this purpose from its own resource-pool. But the underutilisation of the capacity created in public undertakings has been holding them back from earning the requisite surpluses and maintaining the capital intact. The causes responsible for this phenomenon relate broadly to the installation of initially a heavy in-built capacity, recession in the demand for industrial products, operational difficulties, and administrative inefficiencies.

Since the problem of the underutilisation of the capacity created has

been the result of the interaction of several factors, it requires not a few but several improvements. At the Government level, the procedures of assessing the demand for public enterprises and issue of import licences for the procurement of stores, spares and raw materia s will have to be changed. At the public enterprises' level, measures with regard to diversification of production, promotion of product exports, improvement in the interrelations with each other and toning-up of administration are required to be undertaken urgently. The unsocialistic attitude of the workers in public enterprises toward work is also needed to be met with very strongly.

Application of Cobb-Douglas' Production Function to a Small-Scale Industry

N.C. De

In this paper an attempt has been made to examine whether a small-scale industry follows the Cobb-Douglas' production law :

$$P = a\, E^{\alpha}\, C^{\beta}$$

where P is production, E the employment and C the capital ; a, α and β are parameters. For this study the units of the small-scale washing soap industry of the State of West Bengal have been taken into consideration.

Definition and Data

During the period under reference a small-scale industrial unit was defined as one having an investment less than Rs. 5 lakhs or 0.5 million in plant, machinery, equipment, land, buildings and shed (original cost and not the depreciated or book value. For this study, P stands for ex-factory value of production in rupees, E for average number of actual workers and C for original value of plant, machinery and equipment in rupees.

The data were collected from all the small-scale washing soap manufacturing units, excepting a few non-response cases, who approached the State Directorate of Industries for certain types of assistance. The reference period is 1963-64 and the data of 96 units have been considered which constituted more than 90 per cent of the small-scale washing soap manufacturing units existing in West Bengal at that time.

Comparison of Alternative Models with the Help of Empirical Findings

For the purpose of estimation of the parameters a, α and β the usual Method of Least Squares has been applied after making the logarithmic transformation the original variables. As such, for each model, the

estimated values of log a, α and β have been found out and tested by the usual 't' test before the next model is considered. The co-efficients of determination have also been found out.

Symbol : The estimates of log a, α and β are designated as $\log \hat{a}$, $\hat{\alpha}$ and $\hat{\beta}$; the estimates of sampling variances and convariance of $\hat{\alpha}$ and $\hat{\beta}$ are $\hat{v}(\hat{\alpha})$, $\hat{v}(\hat{\beta})$ and $\text{Cov}(\hat{\alpha}, \hat{\beta})$ and the co-efficient of determination is written, as usual, as R^2.

The empirical findings for each of the models considered are shown below :

Sl. No.	*Model*	*Estimates of the parameters and sampling variances and co-variance of* $\hat{\alpha}$ *and* $\hat{\beta}$	*Co-efficient of Determination*	*Hypotheses tested*	*Remarks*
1	2	3	4	5	6
1.	$P = aE^{\alpha} C^{\beta}$	$\text{Log } \hat{a} = 0.8865$	$R^2 = .8042$	$H(\alpha + \beta = 1)$: t=1.1655 with 93 d. f. is not significant at 5% level.	$\alpha + \beta$ may be taken as equal to one and β may be taken as Zero.
	or				
	Log P =	$\hat{\alpha} = 1.1449$			
	Log a +	$\hat{\beta} = -0.0283$			
	α Log E	$\hat{v}(\hat{\alpha}) = 0.0044$		$H(\alpha = 1)$: t=2.1948 with 93 d. f. is significant at 5% but not at 1% level.	
	$+\beta$ Log C	$\hat{v}(\hat{\beta}) = 0.0021$		$H(\beta = 0)$: t=0.6154 with 93 d. f. is not significant at 5% level.	
		$\text{Cov}(\hat{\alpha}, \hat{\beta}) = -.0018$			

1	2	3	4	5	6
2.	$P=aE^{\alpha}$ or $\log P=\log a+\alpha \log E$	$\hat{\text{Log}}\, a=0.8910$; $\hat{\alpha}=1.1207$; $\hat{V}(\hat{\alpha})=0.0029$	$R^2=0.8235$	$H(\alpha=1): t=2.2563$ with 94 d.f. is significant at 5% but not at 1%	α is significantly different from one but the difference is small. The reduction in R^2 is very small.
3.	$P=aE$ or $\text{Log } P=\text{Log } a+\text{Log } E$	$\hat{\text{Log}}\, a=0.9849$	$R^2=0.8140$	—	The reduction in R^2 is quite small; So $\alpha=1$, $\beta=0$ seem to be quite plausible.

Summary and Conclusions

The above analysis indicates that small-scale washing soap industry better follows the input-output model rather than the model of Cobb-Douglas. Actual observation shows that each unit of output requires some inputs of labour and capital; but there is always some excess capital so that variation in investment in plant, machinery and equipment does not apparently influence the production level. Practically, it has also been noticed that, in case of most of the units, after a certain maximum level of utilisation, the capital has remained idle—an example of unplanned investment. And the maximum level of utilisation depends on the availability of some of the main raw materials like coconut oil, mutton tallow etc. which are not always available in this country either in sufficient quantity or at competitive prices. Competition from the large-scale sector of the industry is also partly responsible for this idle capacity.

An idea of unutilised capacity may be obtained for each capital investment group on the basis of 32 units with $\frac{C}{E} \leqslant$ Rupees 333.3 which appears to have worked to near-full capacity. These units show that the

capital requirement per employee is Rs. 237 and the capital requirement for Rs. 1000 worth of output is Rs. 22.9. On these bases the extent of excess capital for each investment group is computed in the table below :

Sl. No.	Capital investment group (nearest to Rs. '000)	No. of Units	Total Employment	Total Production (Rs. '000)	Total Capital investment (Rs. '000)	Min. Capital requirement (Rs. 000) on the basis of		Col. 5 as percentage of Col. 6	Col. 5 as percentage of Col. 7
						Employment i.e. Col. 3x Rs. 237	Production i.e. Col. 4x Rs. 22.9		
0	1	2	3	4	5	6	7	8	9
1.	1	22	93	803	22	22.0	18.4	100.0	119.6
2.	2	19	98	1128	38	23.2	25.8	163.8	147.3
3.	3	17	132	1427	51	31.3	32.7	162.9	156.0
4.	4	8	68	752	32	16.1	17.2	198.7	186.0
5.	5	6	43	445	30	10.2	10.2	294.1	294.1
6.	6	3	24	322	18	5.7	7.4	315.8	243.2
7.	7	1	5	46	7	1.2	1.0	583.3	700.0
8.	8	4	40	406	32	9.5	9.3	336.8	344.1
9.	9	3	46	567	27	10.9	13.0	247.7	207.7
10.	10	2	21	159	20	5.0	3.6	400.0	555.6
11.	11	3	28	174	33	6.6	4.0	500.0	825.0
12.	15	3	29	243	45	6.9	5.6	652.2	803.6
13.	20	1	14	363	20	3.3	8.3	606.1	241.0
14.	21	1	11	134	21	2.6	3.1	807.7	677.4
15.	25	1	16	225	25	3.8	5.1	657.9	490.2
16.	35	1	9	136	35	2.1	3.1	1666.7	1129.0
17.	45	1	12	173	45	2.8	4.0	1607.1	1125.0
All Groups		96	689	7503	501	163.2	171.8	307.0	291.6

Reference : L.R. Klein : An Introduction to Econometrics, Prentice-Hall of India Private Limited, New Delhi, 1965.

The above table indicates that the larger the investment group the larger is the percentage of excess capital involved—not an unusual phenomenon where perspective planning is not done at all.

Another interesting study could have been made had we obtained the machine-hours and labour-hours involved for the production. But this is an impossibility in this country where small-scale units do not maintain even some basic accounts, not to speak of such sophisticated information.

Collaborative Leadership

P. S. Ahluwalia

In India, with rapid advancement of industrial growth, millions of freshers were inducted into the industrial society. This raw labour force gave the fullest scope of exploitation to few disgruntled, irresponsible trade unionists, who could infuse in their minds that industrial discipline is almost a dirty word. The whole thing took a dramatic turn when *hartal*, go slow and emergency strikes were adopted as means of throttling the working of industries. With the help of these powerful weapons of strikes, labour could stretch the striking periods of few of the industries from days to almost a year, with labour and management maintaining a status quo. Once the feelings of labour were aroused, process of reversal became an extremely difficult task. Publicity was given more to excesses than successes. It seems at one time that the industries of labour, for the labour, will perish from the labour.

Irritant Past

The onus of this catastrophe lies with labour but the management too, cannot shirk its accountability. The labour branded executives as *Paisawala*, old diehards, those who do not want to tune their thinking to the modern management style and treat labour leaders as storm-tossed orphans. The only way to make them realise, labour clamoured, is to resort to illegal or legal striking doctrine, as there are dividends in striking. Unfortunately, management felt that the labour is becoming militant to grab off the bigger scoop of cream and still have their belief in the old concept of an economic seige and physical torture, so that the management is led to forced surrender.

Whenever the pressure of strike 'dead-line' is applied by the labour, there is profound upheaval from the management that the new labour force is far more concerned in securing its rights than discharging the responsibilities. Things would have been different if humanisation

could be legislated. It is most unfortunate that it cannot. Well, past speaks for itself. We took more cognizance of machinery and overlooked the human beings who tend the plant. We paid lot of attention to the economics of production and little to the effect upon the human environments. We never bothered about employee's satisfaction with his job, heighten his pride of workmanship, involve him in the decisions that affect him directly. We never thought that coming tomorrow may be altogether different from yesterday and today.

Implementation of this style was possible prior to the advent of organised trade unionism and could continue to pay dividends, till the labour was in a static form having a frozen leadership, fragmented organisation and personal rivalries. Continuous suppression and ill-treatment made the working class conscious of their might and drive the management from the world of their own. Messages like 'unite and organise' have had a stimulating effect upon the working class. With the passage of time, regimentation of labour and their unassuming behaviour could set in motion a change of approach among managers but the attitude of workers got hardened when they noticed the unwillingness of management to pay timely heed to mild and orderly protests from small groups. Thereupon, the workers started applying the intriguing civic arithmetic that if a few break the law they may be punished, whereas if thousands break it, they will be condoned.

Illconceived Solutions

The large scale conversion of conflict-free to conflict-prone industries and trickling of productivity to almost zero forced the executives to change their management style. The idea to work with the flow of tide than to work against it was accepted with a pinch of salt.

Even though, neither historically nor economically, we were ripe for such concept, fussy thinking brought evolution of works committees, joint productivity committees and joint management councils. The terminological confusion made it more difficult to attack the concept. Lofty phrases and glittering promises could hardly conceal the unworkable concept and the mad feeling that what is given today in one form will be taken away tomorrow in another form continued to persist.

Casting my mind back, I can say that the concept of workers' participation even on a limited scale remained only imaginative projection with ideological and theoretical discrepancies.

Collaborative Leadership

In a socialist democracy, labour is a partner in the common task of development to achieve the effective interplay of human and capital resources. The current popularity of participatory democracy forces to consider the concept of collaborative leadership in improving the relations between various fields of industrial forces. This new orientation reacts to ideas than orders and more than even before, it depends on group decisions rather than past experiences. Obtaining of consensus of understanding and motivation are the impressive advantages of this concept. The belief that the new labour generation has no respect for leadership is a thing of the past and the collaborative leadership stresses that respect must be earned by performances and not by mere position of authority. It provides guidelines to three basic issues.

1. Productivity Bargaining:

This concept treats the idea of conventional collective bargaining which fixes wages, hours and working conditions as a futile exercise, with higher prices eating up pay increase before the workers can get to super market. Instead of this, it advocates the kind of productivity bargaining which determines what incentive a management will offer to its workers in return for certain projected increase in the work productivity. It works on quid pro quo approach. It offers a working arrangement for the authority to 'go' and involve workers for increasing work achievements over a period of time and share the gains of profit.

2. Flatter Organisation:

It replaces the traditional vertical or commonly called 'Nose to tail' orientation to flatter type organisation. Increased horizontally, it will increase decentralization. The invigoration of individual rights, board representative, greater informality of working environments and new form of

goal determination, reliable and faster channel of communication and the effectiveness of working with labour are few of the added advantages.

3. Participative Decision Making:

Industry as a prime employer of labour has major accountability for the quality of life of those it employs. This depends upon the type of style adopted to provide either expansion or restriction, spending or saving, delegated or centralised decision making, fixed incomes or variable incentives, higher-than-average profit or lower-than-average profit. We desperately need more managers towards industrial side whose style encourages a greater willingness for individuals to 'have a go' and to use more initiative, to develop innate personnel qualities to the fullest extent, to decentralise decision making as widely as possible and to use carrot more than the stick. Till today, the general industrial work force knows little of industrial aims and their knowledge is limited to occasional press comments to board-room controversy.

People are more important than things and whatever we may say, it is an admitted fact that workers are the nerve centre of the industry and their willingness to do productive work is utmost essential. Participative decision making lays stress on this aspect and urge the formation of board of worker-directors so that final decisions emerge out only after the various controversial points are thrashed out by the implementing parties. The growing suspicion that solitary decisions relating directly to them are taken by outsiders sitting in ivory towers will get curbed. It will encourage spontaneous mutual help pattern and win-loose attitude will tilt in favour of idea generation.

Logic of cooperative approach is compelling and to make it workable, mental make up is necessary. A beginning must be made on a clean slate without any room for fallacies by freezing the past. We all understand that no single foolproof system can be devised to fill the needs of all for all times, but no matter what critics say, solution will have to come from us as no superman can lend a helping hand. It has long been a dilemma for management and labour to decide what responsibility they collectively owe towards industrial stability and I would not be adding one more paper to the hundreds already written on similar concept, had each of us realised this inescapable fact—a need to work and live together in the new hard bargaining climate.

Some Basic Problems in the Way of Development of Small-Scale Ancillary Industries

K. P. Parameshwaran

It has been the experience all over the world that the growth of the large-scale sector itself stimulates the growth of the small-scale sector as a matter of "Secondary and Tertiary" growth which in turn serves as an example for artisans and entrepreneurs engaged in the traditional industries. The modern large-scale industries require a wide range of parts, components and sub-assemblies which they can procure from Small-Scale Ancillary units or from the new plants which may be specially established for the purpose at a comparatively cheaper price, instead of taking up manufacture thereof under the roof of their own assembling units. Small-Scale Ancillary units are, therefore, encouraged with the development of industries as a matter of policy.

In India, the need to develop small-scale units as ancillaries was recognised in the 'fifties' when a positive programme for the development of small-scale industries was drawn up. Significant efforts in this direction, however, commenced only after the constitution of a Standing Committee on Ancillaries by the Small-Scale Industries Board in April, 1960. Initially, the work relating to the development of ancillaries was looked after by the National Small Industries Corporation, but later on towards the end of 1960, a separate Ancillary Division was created in the Central Small Industries Organisation to provide direction and energise the growth of ancillary industries in the country. Since then this organisation is making ceaseless efforts to foster the growth of small-scale ancillary units, primarily to broaden the operational base of this sector of the economy.

So far as the State of Bihar is concerned, the development of ancillaries holds forth fresh and extensive opportunities at this moment. At present there is a large industrial complex at Jamshedpur where units like Tata Iron and Steel Company, Tata Engineering and Locomotive Company, Indian Iron and Steel Company, Tata Robins Fraser, the Indian Tube Company, etc. are located.

In this particular area, the development of ancillaries has been progressing over the past decade or more and new fields are constantly opening up.

The establishment of the Heavy Engineering Corporation at Ranchi, however, has heralded a new era for the small-scale industries of this State. When the Heavy Engineering Corporation gets into its stride the demands of various engineering items would be to the tune of several crores.

Another area which holds forth good promise for the development of small-scale ancillary industries is the emerging Bokaro Steel Plant at Bokaro. This steel plant will not only offer opportunities for various types of engineering items but a vast quantity of consumable stores required by the plant could very well be manufactured and supplied by the small-scale units in the area.

Coming up further north we find the Indian Oil Refineries at Barauni. There is already a proposal to start a Petro-Chemical Complex as an adjunct to this big plant. The location of the Fertiliser Corporation of India to manufacture fertlisers has further enlarged the opportunities for the growth of ancillary units in this area.

Since Bihar offers vast scope for the development of small-scale ancillary units, it has become necessary on our part to consider how the small-scale industry should be reoriented and revived so that it can develop direct supplementary relations with the existing large undertakings and play a complementary role in the planning and setting up of new large undertakings. In other words, it has become necessary for us to consider the relation of large and small industries as a problem in our industrial and economic structure.

Handicaps of the Small-Scale Industry

Before we actually dwell on what the public sector undertakings should do to assist the small-scale industries, it may be worthwhile to examine the handicaps and difficulties which the small-scale industries suffer from and to what extent these difficulties could be removed both by the large sector undertakings and Government. A survey of

the small-scale industries would reveal that they broadly suffer from the following handicaps :

(i) Irregularity of orders,

(ii) Want of essential raw materials,

(iii) Lack of technical guidance at times,

(iv) Obsolescence in means of production and quality control, and

(v) Sales problems of finished products.

These are indeed the fields in which both the large-scale undertakings as well as the Government can render effective assistance to the small-scale industry.

Regularity of Orders : For the survival of any industry and more so in the case of small-scale industries working on extremely limited resources of working capital, regularity of orders is of vital importance. Except for these small-scale industries who have a complete line of manufacture or are making items of capital equipment or such other standard consumable products as are used commonly by industries in general, most of the small-scale units depend very largely on job orders which they receive from time to time from commercial organisations, wholesalers or from large undertakings.

In many instances, the small-scale units perform the function of such contractors but a direct relationship between them and the manufacturers of the end products does not exist. There is often a complex, multiple relationship in which two or three middle agencies are involved. The inter-dependability of big and small industries for regularity of orders although sound in principle, does not always work satisfactorily as due to these complexities, there is no direct relationship between the small and the big units in matters of production and distribution. It is very necessary, therefore, that large and small industries develop a direct relationship with a division of fields of operation to ensure regularity of orders.

Almost all the engineering industries in the public sector have a well defined production programme and have complete technical specifications of all the items that go into the making of their end products.

It should, therefore, be possible for them to prepare a list of all the items with detailed specifications and drawings that they need to bring out to increase their productivity specially those, which are labour-intensive and thus ensure a regular flow of orders to the small-scale sector.

In fact, they should keep a show window of all these items which they used to obtain from sub-suppliers for increasing productivity in their own plant, as well as to minimise their inventory of machines, materials and toolings engaged in the production of the simple items, the manufacture of which is even uneconomic to them on account of their large overheads. It is, however, felt that at the initial stage of planning a large industrial enterprise, the framers must demarcate such stores, parts and components which can be manufactured conveniently by the small-scale sector to meet the requirements of such large enterprises both at the construction as well as at the running stages to foster the balanced growth of small-scale ancillary industries. The problem has, however, been realised and due considerations are being given to this fact to accelerate the tempo of ancillary development in the country.

Even the large industrial undertakings do realise this fact, but in order to ensure continuity of production and elimination of hold ups, there has been a certain amount of resistance on their part to depend too much on the small-scale sector whose quality of products and delivery have been uncertain. On the other hand, due to uncertainty in the receipt of orders very few reliable parties in the small-scale sector have come forward on whom the large-scale concerns could rely for assured deliveries. This vicious circle can, however, be broken quite easily if a proper system of registration of small-scale units is done by the large-scale undertakings after a survey of their installed capacities and the facilities available with them.

Availability of Essential Raw Materials : To ensure regularity of supplies against orders, it may become necessary for the large-scale concerns to make available essential raw materials to the small-scale units. It is a well-known fact that the small units have to pay exorbitant prices for the purchase of raw materials from the small dealers as their working capital resources are meagre and they do not also have the organisational machinery to make economic purchases. Besides, the procurement of scarce or imported raw materials is always beyond their means. In such circumstances, the large-scale concerns must

come forward to help them with the supply of such raw materials as are not easily procurable by the small-scale units at economical prices. It must, however, be admitted here that such relationship can only exist or develop where the small units are situated within easy reach of the large-scale undertakings. And this is also one of the considerations for the location and establishment of a number of feeder units in an industrial estate close to large-scale enterprises

Technical Assistance : It may be seen from the foregoing that with the issue of orders and essential raw materials by the large units to the small units, the relationship between them would grow into a 'social division of labour' and in such a vertical relationship there has to be some kind of informal control by the large undertakings over the small units in the field of technical innovations or even production control. This should not, however, cause an alarm or fear that the small units would lose their autonomy; on the other hand, they should welcome such control on the ground that their business would become more stable. The parent business, i.e., the large units have to maintain a high standard of quality in their products which undergo rigid inspection. Adherence to the specified quality of products is also required as the part of small units who act as sub-contractors and would present little difficulty in their achieving the same if also technical assistance facilities offered by the Small Industries Service Institute and the Directorate of Industries are availed of. Most of the Public Sector undertakings have technical departments which look into the aforesaid functions and it would only mean the dissemination of the technical services to the small-scale units which they should do, if not for any reason, at least for reducing their own ultimate cost of production.

Technical Equipment : The small-scale units, as is well known, suffer from a general inferiority of their technical equipments; most of the manufacturing processes are done on old machines or by manual processes. It is only the inherited skill and dexterity which compensate, to a certain extent, their dificiency in modern equipment. The situation today, however, is very much different from what it used to be more than a decade ago. The National Small Industries Corporation have made available during the last decade a very large number of modern machines to the Small-Scale Sector. Besides, the services of the technical officers of Small Industries Service Institutes are available to solve technical problems of small-scale units. The

available resources have, therefore, to be made use of by the small units and if they still require any help or facility the public sector undertakings should not hesitate to even loan them the shop aids or special equipment required for the manufacture of the components sub-contracted to them.

Sale of Finished Products : Many small-scale units produce their own goods and the public sector undertakings should make use of the same if the standard of specifications and quality meet their requirements. The small-scale industries, however, who produce such complete items of general factory use, should keep the public sector undertakings posted with their line of manufacture so that their products may be used by the public sector industries, whenever possible and in case some alteration in specifications or improvement in quality is called for, the public sector industries should advise the small units how the same could be modified and utilised by them instead of merely rejecting their products on the ground that they are not according to specifications.

In so far as the industries who play the role of ancillary units to the large undertakings or obtain sub-contracts from them, the sale of their products does not present any difficulty as the cost of manufacture is estimated by the large undertakings themselves allowing a reasonable margin of profit in discussion with the representatives of the small-scale units. There is, however, still scope for improvement in the methodology of price-fixation and the services of Small Industries Service Institute can be made available from time to time for this purpose.

It may be pointed out that the Government lays great emphasis on the development of ancillary units in the country. So far as the Government of India is concerned, it has issued a directive to all large scale public sector undertakings that they should have a special ancillary development wing whose job will be to disseminate useful information to the small scale industrialists and to help in the growth and development of ancillary units to the large industry concerned.

The establishment of ancillary units would go a long way not only to increase the productivity but will also help a great deal in import substitution.

Audit of Management Tools and Their Applications

P. Chattopadhyay

Management tools have multiplied several-fold during the last few decades. The process of multiplication is still continuing. Many new areas have been and are being continuously found where these tools are worthwhile and applicable. The tools evolved from different disciplines help countering different kinds of problems faced in business. Not all these tools are appropriate in all cases. The economics of their application also differ from tool to tool and from situation to situation. Thus, it has become imperative for management to be more and more selective about the tools that are adopted in different organizations for application by various rungs of management. Over the years, many of these tools also become obsolete. They have failed to deliver the goods expected of them. It becomes necessary for management to discard some of them when they are no more worth the while or the cost incurred on them is high vis-a-vis their usefulness. Replacement of old tools by new ones requires concerted action to know and judge the cost-effectiveness of individual tools and techniques with reference to the problems that are faced within the enterprise, corresponding to the line of activities chosen, the technology involved, the complexities of production and distribution, the multifarious types of information and analysis necessary, size of the enterprise and the relative labour or capital intensities involved.

Periodic Review—an Imperative

A periodic review and appraisal of these tools and techniques would substantially help management to determine their usefulness and to streamline the applications of these tools and to weed out those that are considered out of date or ineffective. Generally, this approach is not there in most organizations, particularly in our country. The picture afforded is one of coexistence of the old and the new, not so peaceful, perhaps. In certain cases, reflections are made on the tools and techniques when managers who

are supposed to act on the basis of their application are not adequately equipped for using them and the choices indicated by these tools. Lack of knowledgeability apart, these tools and techniques are not only large in terms of species but also genus. Management is required to be alert specially because the process of discarding an old tool is as hard as adopting a new one. The selection process is itself a problem in view of the number involved.

Tentative Classification

Some bases for tentative classification of these tools and techniques are suggested here mainly for the purpose of illustrating the nature and size of the crowd of these tools and techniques, at times at war with each other. It is also important to take note of the fact that many of these tools show contrary results, baffling managers as to their applicability. To suspicious management, patience for probing their real value is frequently absent. The result is that the whole package of these tools and techniques becomes a doubtful proposition. Before dealing with the problem of classification, it is also necessary to mention that these tools and techniques are designed to help management in efficient utilization of resources. If these tools fail in their purpose to present themselves as fool-proof, objective and rational ways of analysis, they lose their markets, or at least become doubtful starters. Like other commodities in the market, the tools and techniques also vie with each other to get sold on the basis of their demonstrated worth.

Economic tools : Among the economic tools of analysis found appropriate for management purposes, models — enterprise models, sectoral models, functional models, allocation-cum-efficiency models, production and cost functions, utility function, etc., may be mentioned. Economists have used several other tools and techniques such as cost benefit analysis, measurement of demand, consumer preference, elasticities, etc.

Management accounting tools and techniques : Among the tools and techniques that are used by management accountants, mention may be made of budgetary control and standard costs, marginal costs, break-even concept, interfirm comparison, balance sheet analysis, project appraisal techniques, etc.

Behavioural approaches and techniques : Several behavioural tools and techniques have come into use in recent times in interpreting different organizational situations. The behavioural implications of some of the techniques evolved by other disciplines are also to be reckoned with in this context. Organization behaviour, decision behaviour, communication, conflict and its resolution, sensitivity training, heuristic programming, etc., figure prominently among the behavioural tools and techniques. The behavioural criteria have been used in constructing organizational profiles, particularly in the advanced countries like the U.S.A., which over time will find greater application in this country.

Quantitative techniques : There are a large number of tools and techniques under this class. Statistical decision theory and other tools of statistical analysis, operations research models and quantitative economic analyses are included in this class.

Engineering tools and techniques : There are different tools and techniques under this class generally used by engineers and technologists. In character these tools are, however, more in the nature of quantitative tools though in many cases even non-quantitative tools also figure.

Another Way

Management tools and techniques can be viewed in another way transgressing the above basis of classification. Taking the elements of management in view, tools and techniques can be classified in the following manner :

Planning : Demand forecasting techniques, measurement of elasticity, enterprise planning models covering long, medium and short-term techniques of project planning, etc.

Motivating : The behavioural tools and techniques and tools of financial analysis are relevant under this class involving cost benefit measurement of ensuring team work in action for purposes of realizing organizational objectives. Coordinating tools and techniques include tools of communication, information technology and accommodation

of feedback. The tools and techniques of controlling are integrally connected with planning which provides the primary scale of reference for control purposes.

Hierarchical Relevance

Similarly, one could classify these techniques as they relate to the top level of management, including the Board of Directors, to the level of departmental managers, assistant managers and further down below. Thus interdisciplinary, interfunctional or interlevel tools and techniques have several common characteristics; they, however, materially differ with reference to the task encountered, the degree of comprehension required, uncertainty and risk involved and the complex data necessary for fitting into the frame of many of them, particularly the models. It is not, however, the purpose of the present discussion to list all the tools and techniques relevant for management. It purports only to show the necessity of periodic review and appraisal of these techniques to get the best out of them in the typical organizational situation in different lines of activities. The importance and presence of elements of choice from these tools and techniques suggest themselves in the context of different species of these techniques under the same genus.

Budgeting *Vs* Higher Business Control

Let us start with the traditional tools such as budgetary control and standard costs. The longevity of budgetary control and standard costs has been very high indeed. It will exceed hundred years in a few years' time if one takes 1890s as the period of beginning of large-scale application of the tools of budgetary analysis. Since then, a large number of refinements and new applications have been found in the context of formulation of standards and budgets, communication of budget targets to different responsibility centres and exercise of control through variances. Incidentally, the behavioural implications of selling the budget to different responsibility centres in the organization have added new features to the traditional approach. As against this, one remembers what T.G. Rose mentioned in the context of the technique developed by him under the brand name Higher Business Control. Rose underscored that budgetary control was

outdated in view of the essential compartmentalization of budget targets and control exercised on that basis. Top management, in his view, had to wait till the feedback information came from below for effecting such improvements or innovations as might be called for. Budgetary control is essentially inward-looking and is not quite sensitive to the changing phenomena of business. Higher business control technique, however, was based on a method of communicating from top downward and was designed to respond to the need for proper exercise of control by the top management which traditional budgetary control mechanism with variance analysis as its sheet anchor has failed to do. Higher business control as a technique, however, has remained much less popular than budgetary control.

Coming of Network Analysis

In the case of standard costing, it has been generally held that this cannot be very fruitfully applied in cases where the job is not repetitive and no previous experience exists. Budgetary control has also been rather out of place in this respect. Development of PERT owes much to these shortfalls of budgetary control and standard costing tools for control of operations. Quite similar in character but much less sung and heard about are two other network techniques named CPM and MOST. In each case, new applications are constantly being tried and have been found.

New Names

Similarly, many new names have been given to the traditional business budgeting mechanism such as output budgeting, programme budgeting and, above all, performance budgeting. All these may be relevant and may appear new in the sphere of administration of government. However, the basic elements of these are already ingrained in the business budgeting mechanism insofar as business budgets involve both quantitative and financial targets of performance. Control is exercised through the scales of reference on the basis of both quantity and value. Different types of variances that are noticed and analysed for this purpose are to be noted in this context; particular mention needs be made of usage variance and efficiency variance.

Project Appraisal Tools

Another genus of tools and techniques has found large-scale application in capital budgeting and project appraisal. The genus can be broadly named as tools and techniques of discounted cash flow involving basically two different techniques, i.e., the net present value and the internal rate of return or the yield method. It has been noticed during the long series of debates on the subject that both the techniques have their relative advantages and disadvantages and, not surprisingly, both have coexisted.

Family of Programming Tools

In the case of operations research, particularly programming, several individual programming techniques are to be noted, all of which have been found appropriate in some situation or the other. Thus, from linear programming and simplex method, one may come to non-linear programming, integer programming, dynamic programming, quadratic programming, stochastic programming, etc. The assumptions involved, the number of variables dealt with and the nature of their relationships, accommodation of uncertainty and risk and the nature of situations in which each of these is found most appropriate differ in each type of programming. Two problems are there in the context of selection of any one of these. First, the elaborate preparation necessary may result in firing cannon balls for killing mosquitoes. Second, the solution suggested by each of these may suggest high opportunity cost vis-a-vis that chosen. Thus, before selection of any one or more, management has to analyse the context of each and its relative usefulness in each case with the large array of variables, the constraints, the assumptions and the conditions in which the solutions are applicable.

Relevance of Audit

The complexities with reference to the evolution of techniques and tools and the uses to which these are put require that these are closely viewed on a regular, periodic basis to determine the suitability of the techniques, improvement in application and better adaptability of the findings of such applications to the interpretation of business phenomena and the decision

making process. The review is required to be conducted by a composite team competent to understand not only the techniques themselves but also the situations in which they are desired to be applied. In this respect, the current status of the tools and techniques may have to be learnt from different sources with reference to the refinements made in the case of each technique. It is also necessary to know the extensions made as respects the areas of their applicability. Audit of management tools and techniques and their application would appear cumbersome on the surface of it, but on the successful application of these tools and techniques the ultimate success of the enterprise would depend. As a part of internal management audit, this kind of exercise would help management in opening up fronts not available otherwise. However, it is to be considered that the benefits arising from their applications should not be less than the costs incurred on them in terms of the personnel necessary, time spent for the purpose and other investments involved. The trends in the application of these techniques, particularly with the advent of the computer, are, however, clearly in favour of analytical sophistication in the managerial decision making process through increasing use of these tools and techniques. In our country, the relevance of this kind of review suggests itself both in the public and private sector enterprises.

Industrial Engineering Concept Needs be Dynamic

S.K. Lahiri

We shall deliberate here on one of the areas of Industrial Engineering, namely, the area of Work Measurement, to show that there is need of some changes in the concepts and the existing tools of work study.

In the area of Work Measurement, the existing approach of industrial engineering and work study, as laid down in the text books and followed by many industrial engineers, presupposes the case of a typical medium size machine shop working on mass production or batch production where the machining operation on any one machine is in the region of a few minutes—less than an hour. In such cases, the operation on each work centre or machine may be considered as complete and independent of the other work centres or machines, and the items machined can be stocked for some time without creating bottleneck. No doubt, such cases do exist in many plants and in such plants, the performance of one machine and its operator can very easily be measured with the existing tools of work study and also in such cases the concept of rating is indispensible, but there are cases, especially in process industries or jobbing workshops, where such text book concepts are not applicable. Here are a few cases :

Case 1 : Process Industries : How do we measure the work of a person in a process working? How is the concept of rating significant where a human being does manual operation for a few minutes or say for a fraction of an hour and then waits and sees till the process goes on for hours ? Typical cases may be blast furnace, petro-chemical industries, gas plants, etc.

Case 2 : There are cases in very large industries, especially heavy engineering industries where machining operation is in the region of a few hundred hours, during which manual working by the operator—which only comprises fixing the job, setting the tool, etc. — may comprise only 3 to 4% of the total hours. How significant is rating of the man in this case ? Or, are not the cutting regime and the tools more significant?

Case 3 : There are components which need operations on a number of work centres or machines. Suppose, on Machine No. 1, operation required is 20 hours, and on some other machine, the operation need only one hour (the situation may be such that it is not possible to balance the load on the machines). Now, if incentive scheme is introduced, there is enough work-load for the operator on Machine No. 1, and he is likely to earn some incentive, but what happens to the operator at Machine No. 2, where the total work-load is for only one hour, i.e. very much less than the time available? But denying some benefit to him also, may nullify the end-purpose.

Case 4 : Imagine a case where there are three or more operations before a product can be declared as complete. Now, suppose at the first operation, the performance is high and the quality is also as per specification, and so the worker gets bonus, but in the subsequent, i.e. 2nd or 3rd operation, the items are rejected. As per ethical consideration, or work-study logic, the person responsible for the first operation should get incentive, but as per the business concept, the organisation will soon go into red, if such ethics is observed for long. So, only complete products should qualify for the incentive.

Case 5 : Group Working : Let us take the case of work measurement when a big group is working as a team, for example, the assembly of an excavator. The prevalent concept has been that each individual, depending on the performance, gets certain percentage of his own basic wage as incentive. Secondly, the industrial engineers have been applying the concept of 'Factor' which are comparative figures showing proportions of the relative contributions of the individuals in a team. Such factors are sometimes arbitrarily decided by the Industrial Engineers basing on his own assessment of the relative efforts, difficulties and skill involved for the different individuals in a team. But lately, both these concepts—distribution at different rates and the 'Factors'—are being challenged by the workers.

Case 6 : Contribution of the Service Department : The existing concept has been to allow certain percentage of the bonus of the production department or the shop to the services department, but we are all aware that slightest lacuna in the working of the services, namely, either gas supply, power supply or water supply may dislocate the working of the whole department or the whole plant.

The few points raised above need serious thinking on the part of the industrial engineers. The fact is, so long work measurement and formulation of incentive scheme were the prerogatives of management who depended on the industrial engineers who in turn relied on text books which dealt with only typical cases and applied the same concepts and the same formulae to tackle all such cases arbitrarily.

A time has come when these concepts are not considered relevant in many of the cases depicted above, and in some cases these are being challenged by workers. So, the industrial engineers have to add a few more concepts and tools in their kit.

While this paper does not claim to provide answers to the implied question, it does suggest for many situations as above the narrow sectoral concept of work measurement is not sufficient. Rather, the concept of "Total Approach" is the answer. For example, the totality of the performance of a group of employees or department or division or even of organisation is more relevant or significant.

In fact, the concept of total approach has already been established in the field of Quality Control. Thus, we find now-a-days total quality control and not quality control in one operation. Similarly, we find the advent and certain growth in the concept of Total Design, and another addition in the field of Planning is of Corporate Planning where concentration is not on functional planning in any one aspect, but a comprehensive, inter-connected and an integrated approach to planning in the whole organisation. The final and end objective is to be supreme and not the separate individual efforts. The organisation is more important than one man or one individual.

On the Explosive Bulging of Cylindrical Shaped Parts

S.K. Ghosh **V.C. Venkatesh**

Explosive forming is best described as a process in which metal parts are formed by the high pressures resulting from the detonation of chemical explosives. Following the detonation of an explosive, a high pressure gaseous bubble is produced which goes through an oscillatory motion until it vents at the surface. The weight of the explosive and stand-off distance combinations for many forming operations are such that the bubble 'breaks' over the surface of the workpiece[1]. This aids in forming of a spherical bulging of a sheet material to dome and a cylindrical shape to bulged cylindrical parts. The important feature in such a process is that the mode of the transfer of energy for deformation conforms with the shape of the part to be formed.

Explosive forming and sizing have been applied to the production of rocket motor cases, sound suppressors for jet aircrafts (typical example being that of Boeing 707, 727), pressure vessels, and a large variety of other cylindrical parts.[2] These items range in diameter from about 3 cms. to several metres, with lengths of from several cms. to 5 metres and the operations use both open and closed die systems, and high and low explosive charges.

The forming of cylindrical parts is normally concerned with the expansion of tubular shaped preforms, the operation being carried out in a split die to facilitate removal of the formed part. The shape of the explosive charge is important in this type of operation, since it depends on the area of the tube which needs to be formed[3]. For a component, where forming takes place over its entire length, a linear charge is the most efficient. On the other hand, where local deformation is required, a point or spherical charge at the position of maximum

1. J.S. Rinehart and J. Pearson, "Explosive working of metals" Pergamon, 1963.
2. F.C. Pipher, G.N Rardin and W.L. Richter, "High energy rate metal forming" Engineering Report Lockheed Aircraft Corpn. California, 1960.
3. D.S. Adams, V.S. Harrison and J.P. Orr, "High energy forming of metallic sheet materials", Report No. 61B073, Ryan Aeronautical Company, California, 1961.

deformation is more suitable. The operation may be done in air, water or any other energy transmitting medium depending on the size of the workpiece[4].

Test-Rig

Fig. 1 shows a split die where a 50 mm o.d. and 85 mm length tube can be placed. The locating pins are used to match the impressions on both halves of the die after clamping done by means of 4 x M 12 bolts. A slight mismatch in the die will cause radial flow of metal along the resulted gap along parting line. The desired amount of diametrical bulging of the tube is 12 mm at two positions as shown.

In case of free forming, no die is used to restrict the bulged shape and size.

Experimental Method and Procedure

The materials used in case of bulging in a die are seamless austenitic stainless steel and 60/40 brass tubes of dimensions 50 mm o.d. x 2 mm wall and 50 mm o.d. x 3 mm wall respectively. A tube is kept in one half of the die and the other half is bolted to it after securing the locating pins in proper position. The die is kept vertically and a measured amount of special Gelatine 90 explosive charge—aluminium cap type electric detonator assembly is kept centrally within the tube maintaining a suitable stand-off distance. The lead wires from the detonator are connected to a 6 volts d.c. supply through a 2-way switch. After the detonation is done, the die-halves are open and the part is taken out to study the bulged dimensions and hardness at the apex.

For free forming, 2 mm thick stainless steel sheet is rolled, formed and welded to a 150 mm o.d. x 500 mm length cylinder. Similarly, a mild steel cylinder of dimensions 5 mm thick x 250 mm o.d. x 500 mm length is manufactured. Measured quantity of the same explosive, as mentioned above, is kept centrally within the tube filled with water

4. W.W. Wood, "Theoretical Formability—Volume II—Application", Report No. 61-191, United Aircraft Corporation, Texas, 1961.

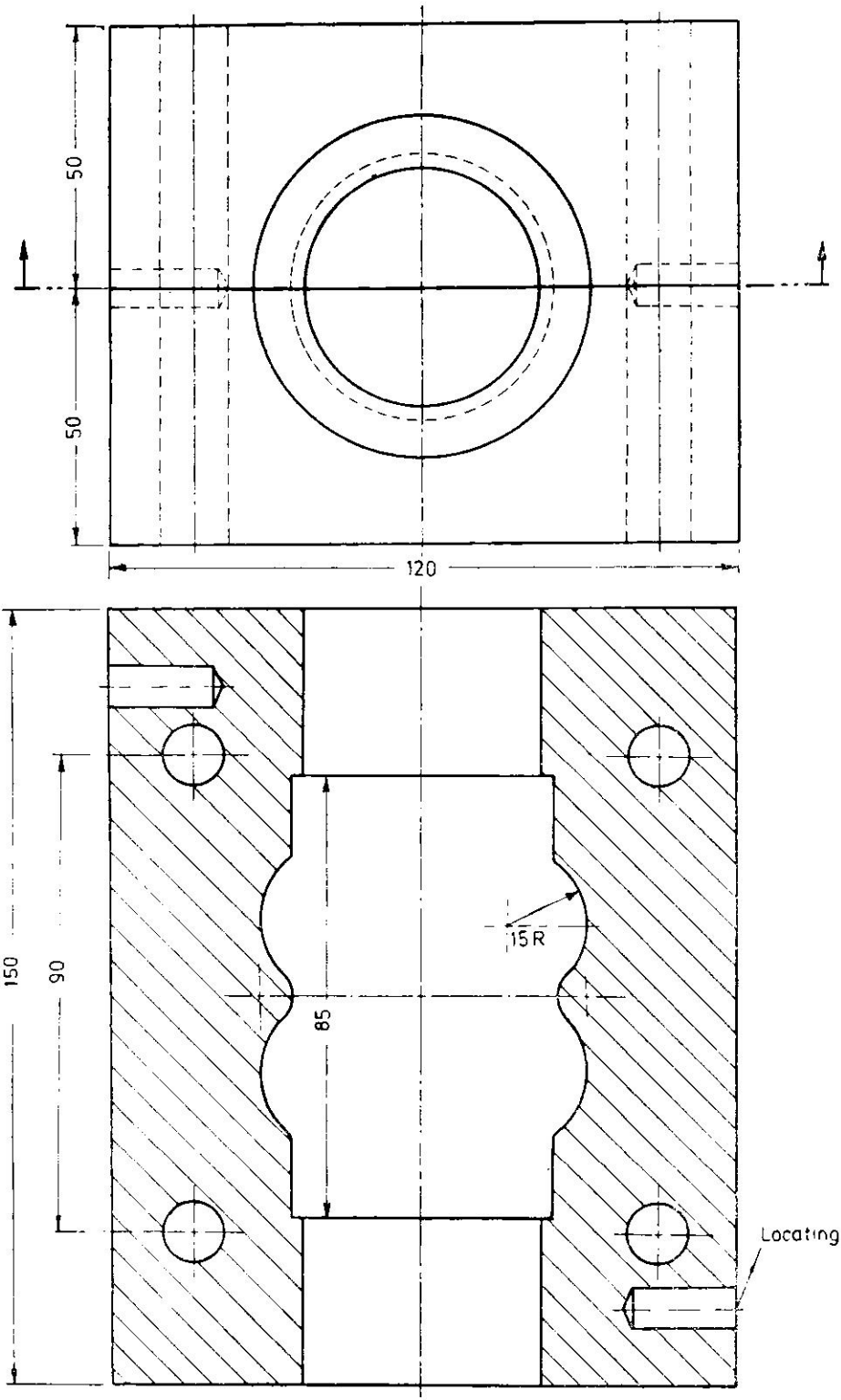


FIG. 1. BULGING DIE

and bulged. Additional explosive charges are used in steps to determine the bulging by each explosion. Hardness of the apex regions is studied after the final explosion to study the effect of impulsive loading.

Results

The die-bulged tubes are shown in fig. 2. The free-formed stainless steel and mild steel cylinders are shown in fig. 3 and fig. 4 respectively.

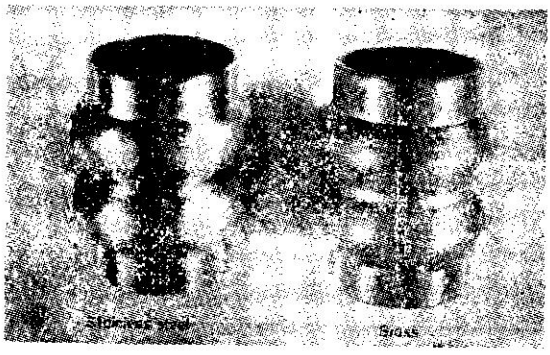


FIG. 2. BULGED CYLINDRICAL PARTS

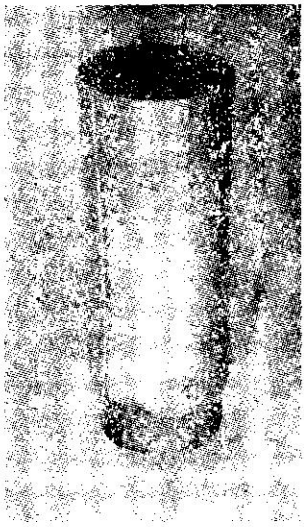


FIG. 3. BULGED STAINLESS STEEL CYLINDER

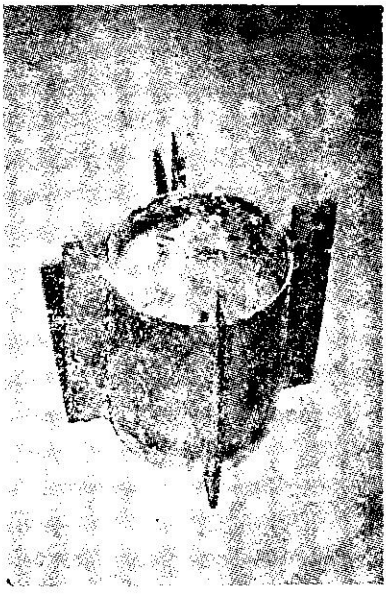


FIG. 4. BULGED MILD STEEL CYLINDER

Management of Scrap and Rejects

S. R. B. Manian

In the first stage rejection of material takes place when it is received from suppliers and inspected at the Goods Inwards Department. A second stage rejection takes place when the material is machined and a stage inspection takes place. A third type of rejection occurs at the assembly stage when, water test, hydraulic tests, etc. take place. Through management of scrap we can get an intimate insight into the weak spots in the organisation of men, machines and material. The following will give some idea of the complexity of the effect of rejection :

1. The first step will be to intimate suppliers about the rejections and the reasons for the same. This is achieved by posting a copy of the Goods Inwards cum Inspection Report, if it is at the receiving point. But if the rejection takes place in the course of processing the material, i. e. either machining or assembling, then a copy of the stage inspection report is sent.

2. If material is lost in transit or damaged in transit, we will have to prefer a claim on the transport contractor (railways or lorry operator). Debit Notes are raised on the transport contractor and when the bill of the supplier is passed an appropriate amount is debited to claims account.

3. If a Debit Note is raised for rejection or if it is adjusted in the suppliers' bill itself, we will have to include appropriate sales tax, carriage inwards, transit insurance, handling and packing charges.

4. If the rejection is on the line besides cost of material, cost of machining up to the stage it is rejected and other charges stated above will have to be included in the Debit Note.

5. If the material is steel, normally a sample of it is taken for testing to find out whether it conforms to the specifications stipulated by the manufacturer, like tensile strength, chemical composition, hardness

etc. Such charges are normally recovered from the supplier.

6. After a batch of components or other raw materials are rejected as soon as they are received and inspected, immediate action is required to arrange for replacement so that the production flow is not affected unless sufficient stock is carried to allow for such contingencies.

7. An adjustment in the machine loading chart is required so that the machines are properly loaded in order to fill in the gap created in the production flow by the components scrapped or found defective.

8. Rejects and scrap material will have to be stored, till they are disposed off. Rejects may have to be reclaimed sometimes and scrap material are sold or used in one's own foundry if suitable.

9. Sometimes what is found to be scrapped is also used for alternative purposes. For instance if an item is found to be undersize for one gear unit, it can be used for the next size of the gear unit.

10. Delays in arriving at a decision as to whether an item is to be scrapped or salvaged sometimes distorts the statistical reports on scrap as it will be incomplete.

11. If supplier sends documents through bank, we should also send scrap or rejects through bank. If so, the question as to who should bear the bank commission, carriage outward etc., is an important matter that should be decided.

12. A study of the rejection of scrap due to its various causes is a must, such as whether it is due to (i) supplier's fault (ii) operative's fault (iii) fault of defective equipment and tools etc. This will help in eliminating repetition of the same in the future.

13. If rejections are due to defective material supplied by the supplier then a further study of the performance of each supplier will be necessitated. A performance card for each supplier should be maintained so as to show the quantity ordered, the quantity received and the percentage of rejects or scrap for monthly or quarterly periods. If the performance of a supplier is consistently

bad we should find out an alternative supplier, or make alterations in the specifications; for instance, if hardness limits are too stiff we may relax the limits.

Study of Scrap Occurring in Each Department

If there are different departments where processing takes place, then a study of the scrap occurring in each department and a comparisor of the same between departments (if they are comparable) and between periods (say monthly or quarterly) will help in controlling the scrap, rejects or rectification cost. A sample study is given below (table 1) :

TABLE 1

Shopwise Scrap Related to Production

(Rupees in lakhs)

Shops or departments	*1967*			*1968*		
	Scrap Value	*Prodn. Value*	%	*Scrap Value*	*Prodn. Value*	%
1. Foundry	5.66	23.53	24.00	6.98	37.76	18.49
2. Machine Shop :						
(a) Scrap due to m/c shop fault	8.73		6.90	9.64		6.66
(b) Scrap due to foundry fault	1.73		1.37	1.70		1.17
(c) Scrap due to outside suppliers' fault	1.62		1.28	3.45		2.38
Total M/C Shop :	12.08	126.36	9.56	14.79	144.75	10.22
3. Assembly Shop	1.26	314.70	0.40	2.07	424.64	0.49
Total	19.00	314.70	6.04	23.84	424.64	5.61

Normally the scrap percentage is calculated on the basis of the total output, i.e., the scrap value is calculated by adding the scrap cost to the

total output which is considered to be good. In the above example the scrap percentage is calculated as a percentage of the output.

Another important check would be for us to calculate another two ratios as per formula given below :

1). $$\frac{\text{Output}}{\text{input} + \text{labour and overheads for the total output}} = A$$

2). $$\frac{\text{Scrap Value}}{\text{input} + \text{labour and overheads for the total output}} = B$$

Ratios A plus B should give us a value of approximately one, considering opening and closing W.I.P. to be constant. Otherwise we can conclude that either certain scrap reports have not been taken into account or certain production values have been omitted. Of course, the above proposition will not hold good in the case of foundry production where the input is subject to a burning and melting loss. Where the finished product becomes the raw material (as in the above example) of the subsequent processes, the total scrap percentage of the factory will have to be calculated on the final finished product cost or the sales value of the finished goods. It will not be just the progressive totals of the shopwise percentage of scrap.

The scrap percentage of the different shops should also be compared with the percentages of scrap reported for similar production units outside the organisation. This will help us in analysing the reasons for the high percentage in scrap which may be due to (i) the raw material being sub-standard or not being of proper specification, for instance pig iron quality in a foundry (ii) production facilities such as machine tools, jigs and fixtures, cutting tools etc. not being uptodate or outmoded and (iii) operator's being not properly trained or unskilled or wantonly spoiling material due to dissatisfaction in service conditions etc.

Scrutiny of Departmental Scrap

We must study for this purpose (i) the stage at which the scrap or rejection occurs and the frequency with which it occurs at different stages of the operations (ii) scrap due to operator's faults (iii) scrap due to

machine tools, jigs and fixtures etc. and (iv) faulty material. Some of the studies made are given below :

We have seen that in Table 1, the scrap percentage of machine shop due to foundry fault is 1.37 and that due to machine shop fault is 6.90 in 1967. But from the Table No. 2 it will be clear that in respect of certain important components the scrap percentage is very heavy. More attention should be paid to these components. If we concentrate our attention to components where the percentage is more than the general average, we will be solving the problem in a better way than worrying ourselves with every component where there is a rejection. This is what is known as the control by the "principle of exception".

TABLE 2
Componentwise Study

COMPONENTS	1967					
	Machine Shop Scrap due to foundry fault			*Machine Shop Scrap due to machine shop fault*		
	Qty. rejected	*Prodn. Qty.*	*% rejection*	*Qty. rejected*	*Qty. Produced*	*% rejection*
1. F model Cylinder Head	13	111	11.7	93	887	10.48
2. Y model flywheel	118	2733	4.3	20	3485	0.57
3. Pawl Carrier	107	682	15.7	60	240	25.00
4. Crank Case	5	202	10.9	80	300	26.67
5. Adoptor Flange	36	270	13.3	14	52	26.92
6. Connecting Rods	—	—	—	50	200	25.00

Another aspect where attention is required in Table 2 is whether the material rejected or scrapped is a very costly item or a low-priced item. Item 6 in the table is an imported component and the rejection percentage is very high. When we know that foreign exchange is involved in importing the item and that it will take a lot of time to apply for import licence, getting the licence, placing the order etc. and getting the actual consignment for replacement of the scrapped component and hence there will be a heavy production loss, we must devise all possible ways at our command to control the rejection of this item.

TABLE 3

Operationwise Monthly Rejection Frequency for Cylinder Heads

Month 1967	Prodn. of final finished goods	Prodn. of components	Scrap in M/C Shop	% scrap	Quantity rejected at different operations at machine shop																	
					1st operation		2nd operation		3rd operation		4th operation		5th operation		6th operation		7th operation		8th operation		Total	
					M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Jan.	50	53	20	37.8	2	—	4	2	—	3	2	1	—	—	1	—	4	1	—	—	13	7
Feb.	50	99	26	26.3	1	—	1	3	—	2	—	3	—	—	2	1	11	—	—	2	15	11
Mar.	75	27	22	81.5	4	—	3	10	—	1	—	—	—	—	—	2	—	2	—	—	7	15
Apr.	31	76	10	13.2	—	—	—	1	—	—	—	—	—	—	3	—	—	—	3	3	6	4
May	48	63	17	27.0	—	—	—	3	3	—	—	—	—	—	—	1		—	9	1	12	5
June	106	90	54	60.0	—	1	—	6	—		4	1	—	—	—	—	—	12	30	16	38	
July	21	34	15	44.0	—	—	1	4	—	1	—	—	—	—	1	—	—	—	7	1	9	6
Aug.	50	75	6	8.0	—	1	—	—	—	—	2	—	1	—	—	—	—	—	1	1	4	2
Sept.	18	51	21	41.0	—	—	—	13	—	—		4	—	1	—		—	—	—	3	—	21
Oct.	54	27	13	46.5	—	1	2	2	—	4	—	1	—	—	1	1	—	—	—	1	3	10
Nov.	57	54	20	37.1	1	—	—	9	—	2	1	3	—	—	—	—	—	4	—	6	14	
Dec.	65	47	26	54.2	—	1	1	15	—	2	1	1	—	—	—	—	—	1	4	3	23	
Total	625	696	250	35.8	8	4	12	68	3	15	10	14	1	1	8	5	15	3	37	46	94	156

Note : M means rejects due to machine shop fault.
F means rejects due to foundry fault.

Operationwise Analysis of Scrap

In respect of components in which heavy rejection occurs, it will be worthwhile to study the particular operation in which the rejection is heavy. The frequency of occurrence of rejection for such components should be tabulated for a month or quarter operation-wise.

From Table 3, if can be seen that the frequency of occurrence of scrap or rejects is highest in operations 2 and 8.

Besides, the rejections have been heavy in June though the production of components is not higher than that of the month of February, when the rejection has not been as high as in June. Has this got anything to do with the quality of material supplied in that month? Then certainly the inspection department should be held responsible for accepting substandard material. Thus by a process of elimination of causes and concentrating on the extraordinary situation we will come to know a lot of the deficiencies in the set up of the organisation, deficiencies in men and material.

Operators and Machines

As given in the above statement if we can take one operation of a component and tabulate the rejects in respect of that during a given period in regard to men and machine, we will get quite an interesting and illuminating picture of the occurrence of rejects (table 4).

TABLE 4

Component Code No.	*Operation Code No.*	*PERCENTAGE REJECTS*					
		Operator Token No.			*Machines*		
		201	*250*	*305*	*M-200*	*M-500*	*M-33*
X-211	1411	5.0	2.0	3.0	3.1	3.4	3.5
X-119	1185	12.0	13.1	11.5	11.3	11.2	10.9

In the above example it appears the operators are at fault rather than the machines, since all the three machines are giving a uniform percentage of scrap, whereas the percentage of scrap of the different operators widely fluctuate. If it is the other way about, we must find whether the machines have lost their accuracy and whether they need replacement.

Rectification and Rework

Components rejected due to machining fault are sometimes reclaimed by doing certain operations again or by rectifying some of the defects by welding, filing, grinding etc. It is the experience of many of the Indian manufacturers that components supplied by sub-contractors are not according to specifications and that majority of the components have to be rectified before acceptance. Leaving aside the cost of rectification the time loss involved in rectification holds up production and there is always a bottleneck in the flow of production.

Two examples are given below to illustrate the magnitude of the problem faced by manufacturers. In one case study rectification was done on 326 components of a particular assembly totalling 235 hours and costing Rs. 3669. This formed 12.3% of the total units assembled. Monthly figures are given in table 5.

TABLE 5

Month	*Quantity*	*Time*	*Lab. & O/Heads Rs.*	*Month*	*Quantity*	*Time*	*Lab. & O'Heads Rs.*
Jan.	19	16	129	July	38	46	439
Feb.	35	52	477	Aug.	3	6	61
Mar.	1	1	11	Sept.	6	10	73
Apr.	3	3	31	Oct.	114	59	1524
May	6	2	13	Nov.	69	21	562
June	—	—	—	Dec.	32	19	343
Total	64	74	667		262	161	3002

There has been more rectification work in the second half of the year than in the first half. If we study the reasons for this increase in the second half, we may get a clue as to what should be done to prevent its recurrence.

The labour cost of rectification and rework incurred in a factory during five years is given in table 6.

TABLE 6

Year	*Wages cost of rectification* Rs.	*Total direct wages of the shop* Rs.	*% of rectification*
1964	17698	908680	1.76
1965	12811	1004030	1.29
1966	17238	1171890	1.47
1967	18907	1308655	1.45
1968	21817	1713911	1.28

The cost of rectification (since it is mainly in respect of components supplied by sub-contractors) should be recovered from them. But since many of the suppliers of components belong to the small-scale industries it has been the experience that it is nearly impossible to do so.

Reclamation of Scrap

Some of the scrapped material can be reclaimed by putting them to other uses, say for bars and rods. Scarce imported special and alloy steel can be used in fabricating some of the spare parts required for the machinery. Similarly end pieces can be used in manufacturing bushes, bolts and nuts etc.

Even if they have to be sold as scrap, they should be properly sorted out, classified and sold. For instance, bronze and aluminium scrap will fetch a better price than cast iron scrap.

Accounting Treatment for Rejects and Scrap

Treatment by neglect : In this method the cost of the rejects and scrap is absorbed in the cost of the good units produced. Cost of rejects to the extent that it is not recoverable from outside suppliers is taken into account.

Treating the cost of rejects and scrap as an overhead cost : Usually the cost of rejects and scrap is debited to a separate scrap account. Then they are changed to the product on the basis of a machine-hour rate or a man-hour rate. If we do so the cost of the scrap of a particular component of a product manufactured will not necessarily be loaded on the product itself to the extent it should bear. The reason for this is as follows :

Generally issues and receipts are taking place during a month on a day to day basis and they have to be costed also on a day to day basis and cannot wait for the actual cost to be worked out. The rates applied are a predetermined rate esp. for labour and overheads and are normally used for a quarter. An example will make the position clear (table 7).

TABLE—7

Product : Crankshaft	Unit	*Jan.*	*Feb.*	*Mar.*	*Pre determined Price*
1. Cost of material (average)	(Rs.)	500	510	510	
2. Cost of material (FIFO)	(Rs.)	490	500	510	500
3. Time spent	(Hrs.)	10	15	20	10
4. Rate per hour	(Rs.)	22	25	20	20
5. Overhead and labour cost	(Rs.)	220	375	400	200
Total Cost	(Rs.)	710	875	910	700

The actual cost in Jan., Feb., and March are different from the pre-determined rate. The actual cost cannot be used for pricing issues as they can be computed only after the expiry of the month. As such the pre-determined rate is used. So the actual cost of a particular period can only be of that of a previous period. When a product is assembled, (if we adopted the actual cost basis) its cost for a particular month will contain the cost of foundry (say) of January, Machine Shop cost of February and the assembly cost of March, as it takes time to go through each process. The cost of the rejected components is, therefore, based on a pre-determined rate.

Leadership in Business : A Critique Based on Porductivity

S. K. Jain

Can a manager help in improving the competitive situation of the U.S. business under the present pressures from other countries, specially Japan and Germany ? To what extent can he make contributions with regard to increasing the productivity in his own organization and thus answer the role of a leader in this sphere?

In very simple terms, it can be understood and given that Profits=Total Revenues — Total Costs.

A manager is interested and also his prime objective is to increase these profits through efficient and effective means. Machines, materials, time, methods or processes and men are needed to make a product ; and it becomes evident that these are the factors which should be controlled and viewed by a good manager to satisfy his objective of attaining greater profits. Productivity increase will be one key area where the present manager has to be very cautious and informed. He will have to take a lot of initiative for improving the productivity of his division and organization.

What Productivity Means

Increased productivity essentially means putting "more product into a product" — that is producing more of something with the same amount of material and resources, or equal production with a lesser input of factors which contribute to the product's cost.

The result is a better deal for the consumer, a desirable goal in itself. But the manager who learns how to reduce the unit cost of his product, benefits also as he offsets the rising costs of materials and labour.

Productivity Rate of U.S.

When asked how foreign competitors are able to make inroads into our

own economy through marketing of their products, government and corporate officials often have the same answers. They make charges of dumping and point out that many foreign markets aren't open to U.S. business in the same way as ours are open to foreign counterpart.

We have also heard of high labour costs, but I would say that this factor is often obscured by increasing labour costs in other countries also. What I would say is that we in U.S. are increasing the industrial output at a slower pace than many of our competitors.

From 1959 to 1969 (10-year span), the U.S. experienced a growth of 2.9% in output per man-hour, less than any of the other major industrial nations. It is surprising to note that during the last five years of the 60's which is often called the boom period, the productivity growth rate slowed to 2.5%.

While the American worker was able to increase his productivity only 2.9% a year, he was able to get wage increases that averaged 4.6% a year. The manager must ask, why ? and how could he play an effective role?

Productivity Compared with Other Countries

Germany's growth rate of productivity rose to 6.4% and Japan's to 13.4% during the same period of the 60's.

Unit Costs — the result of the two trends :

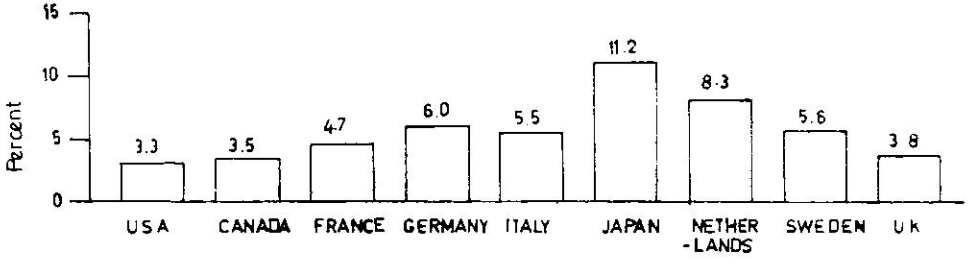
(a) The productivity growth rate

(b) Wage increase is reflected in the unit labour costs; the amount a manufacturer must pay for labour as a ratio of what labour can produce.

From 1959 to 1969, unit labour cost rose 1.7% a year in the U.S.A. while in Japan it rose to 0.5%.

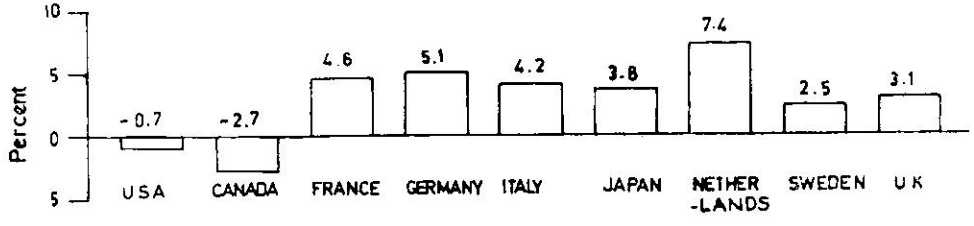
From 1965 to 1969, unit labour cost increased 3.1% a year in U.S. while in four of the other nine major industrial nations, including Germany, it declined.

AVERAGE PERCENTAGE CHANGE IN PRODUCTIVITY, 1960-69



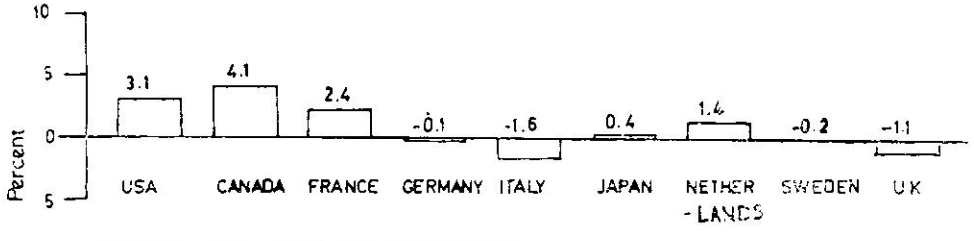
SOURCE: U.S. DEPT. OF COMMERCE

AVERAGE CHANGE IN MANUFACTURING UNIT LABOUR COST, 1960-65



SOURCE: U.S. DEPT OF COMMERCE

AVERAGE CHANGE IN MANUFACTURING UNIT LABOUR COST, 1965-69



SOURCE: U.S. DEPT. OF COMMERCE

Japan — The Japanese are honest compared to many industrial nations of Western Europe, when they say that their success in productivity gains has been achieved with U.S. guardianship and aid.

Dr. Nakanishi who is Managing Director of the Japan Productivity Center says that no productivity movement can succeed without mutual understanding and cooperation between labour and management. "Fortunately for Japan", he observes, "both labour and management cooperated closely with each other to improve the productivity of Industry"[1], and this cooperation is continuing.

It is very surprising to note that in 1955, the very creation of Japan Productivity Center to develop a nationwide productivity movement was made at the suggestion of the U.S. government.

Germany — Germany which stands with Japan as example of high level productivity, draws largely on the work ethic of its people as an underpinning for increasing output.

Motivation to work is a national characteristic of the Germans, and along with it is a tradition of training and educational system which places emphasis on vocational as well as professional and managerial skills.

Labour shortages have provided an incentive to management for investment in new plant and equipment to improve output per manhour. Labour also has very little resistance to improving output through new processes and new equipment.

Viewing from the existing state of affairs and our critical position in the business market, a question arises as to what a manager can do in solving these problems ? What and how can he contribute to the productivity movement ? Can a manager try to achieve and play the role of a leader in this movement and, if so, how ?

Who is a Leader

Leader is a man, who can be looked up to, whose personal judgement is

1. Productivity & the Global Market - Keep America Competitive- A Special Report—Plant Operating Management, May, 1972

trusted, and who can inspire and warm the hearts of those he leads—gaining their trust and confidence, and explaining what is needed in language which can be understood. It would seem, therefore, that the beginning of leadership is a battle for the hearts and minds of men, and this is the essence of the matter.

The first approach to leadership should be intellectual. A leader should have the capacity and the will to rally men and women to a common purpose, and he should have the character which will inspire confidence.

Leader as a Manager

A leader is an "ideal manager" in crude language. A manager aspires to become a leader. In our discussion, *we shall assume* that it is basically the manager who is responsible or who has to be active in this productivity movement. And this manager ultimately has to assume the role of a leader.

In the present technologically oriented business world, there are various modern and recent ways through which a manager can help to obtain productivity gains, like

(i) Benefit to productivity in research & development

(ii) Incentive Plans

(iii) Labour cooperation

(iv) Improve work attitudes

(v) Motivation

(vi) Productivity bargaining

(vii) Behavioral-leadership qualities.

(i) Industry, to enhance its competitive position internationally as well as to produce goods more efficiently, needs to do more to develop more products. This will involve managerial skills for increased R & D efforts.

(ii) If we have to achieve an economy that offers higher wages on one hand and higher profits and stable and competitive prices on the other, the manager in the division must accept and try for innovation and productivity as a way of life.

The only way which seems logical and workable is to succeed and to gain mutual recognition by both the manager and the worker of the advantages of doing this.

(iii) This is one area where a manager has to show his ingenuity to get favourable response for expecting productivity gains. Labour's cooperation cannot be forgotten, or rather it is indispensable in both increasing productivity and creating a favourable climate for the productivity improvement.

To the worker, higher productivity can be misinterpreted as meaning that he must work harder so that somebody else will make more money. A manager has got to take a lead and convince him that his fears are groundless and that he will share fully in the reward of increased productivity.

A manager can play a very effective role if he can say these things, with conviction—and if this becomes a common cause of labour and management of his organization.

(iv) There is always a human dimension affecting productivity and acceptance of the so-called work ethic. The worker dissatisfaction normally exists because of unpleasant working conditions, poor pay or routine operations etc. The thrust of President Nixon's new programme for improved science and technology is to achieve, in his words, "A strong new effort to marshal science and technology in the work of strengthening our economy and improving the quality of our life".[2]

For the manager who is aspiring to become a leader, the challenge lies in taking a new look at the work environment. Methods of doing more of the total jobs to increased responsibilities for the young worker—and perhaps an allowance of time off to devote to social concerns (like four-day work week) should be worth consideration by the manager.

2. Keep America Competitive –A Special Report—Plant Operating Management, May, 1972.

The manager has got to be much more concerned about work attitudes as they relate to today's value structure.

(v) It is very rightly said that managers are the basic resource of business enterprise. They are the most expensive resource in modern business, and also the one which could depreciate the fastest.

In order that a manager should succeed, the first thing he has to recognize is the problem of human alienation. In order to cope with this problem, the manager must play a leading role in making an endeavour to respect the dignity of each individual in an organization and to identify his goals with the goals of his people and finally with those of the organization.

Now comes the big issue as to how to work in this direction. It is this area where the manager has to play the role of a leader in motivating his people.

Human capability is a critical resource, one which is extremely variable. In fact latent human capability may very well be the greatest untapped resource. In general, productivity depends upon two major variables :

(a) Employee's job performance
(b) resources utilized

The resources illustrated are raw materials and technology. Obviously any improvement in technology can make a significant change and difference in the productivity of the system. In automated systems, the human element is not very important. However, we must realize that in most organizations the performance of the employee is relatively more important than the equipment and raw materials. Even in automated operations, productivity at organizational and institutional levels is almost entirely dependent on human performance. The productivity of the individual depends primarily on ability and motivation to perform. Physical and physiological attributes are involved in determing the ultimate capacity for an individual; and his level of attainment within a certain range will depend upon experience, training and interest.

Productivity in organization is determined to a great extent by the

member's motivation and degree to which their actions are directed towards organizational objectives. The relationship is :

$$P = F(M) + F(D)\ E' \ldots\ldots + F(N)$$

This is productivity and a function of motivation plus a number of other factors that can be present in particular situations. Motivation may be plus (also called "positive", the "carrot" and "anxiety reducing") or minus (also called "negative", the "stick", and "anxiety producing"). Discipline is a measure of the extent and of the consistency with which the actions contribute towards achieving objectives, and it can be internal or external.

(vi) Our productivity record during these past five years makes us think that we are running out of technological gas. Should we as managers be satisfied with this argument? Apart from various areas under discussion, productivity bargaining seems to be a new route to increased productivity that shows promise. Concept of productivity bargaining emphasizes a special aspect of bargaining over wages, hours, and working conditions. In this type of bargaining, the manager as a part of the management team offers employees incentives for changing work rules, practices, or methods to increase productivity.

This concept has worked in Britain. In fact, one study of 40 British companies reveals that three-fourths of them realized either lower unit costs or reductions in total labour costs as a result of productivity bargaining.

The manager has to play a leading role today in emphasizing to his people and the top management about recognizing the goal to attain and sustain productivity growth and a means of realizing this goal is productivity bargaining.

(vii) The factors mentioned before are the key points in the present concept of productivity which a manager has to deal with. But there are other managerial concepts also which have to be looked into. They are : (a) leadership, (b) organizing, (c) communicating, (d) planning, (e) controlling the organization, In order that the manager assumes the role of a leader he has to perform and has to be very alert in the following areas also:

(a) *Arbitrating* : Often members disagree on the base decision for an organizational matter. An effective leader will resolve this disagreement by arbitrating.

(b) *Suggestive* : Suggestions are often employed by an adroit leader. The manager may say, "I believe it will be the best to do it this way". Suggesting often permits the subordinate to retain his dignity and sense of participation more than if he was given a direct order. For the long term, the power of suggestion is likely to be a powerful tool in the manager's kit.

(c) *Supplying Objectives* : A manager often personally supplies objectives which will allow members to work together. These organizational objectives do not usually appear automatically. Effective objectives are more often the result of deliberate action. The manager must see that the organization is always supplied with suitable objectives.

(d) *Catalyzing* : In organizations some force often is required to start or accelerate movement. A manager may provide this force. When he is doing this, he is acting as a Catalyst. He stirs his subordinates to action.

(e) *Providing Security* : In organizations, personal security is often a significant factor. A manager can provide a large measure of security by maintaining a positive, optimistic attitude, even in the face of adversities.

(f) *Representative* : A leader is usually representative of his organization. It's the leader's impression that creates the image for the entire organization.

(g) *Praising* : A good manager will always praise the employee for doing a good job. This aspect can help to satisfy the need of self praise by sincere efforts.

Other qualities which a manager has to exercise to play the role of a leader are :

Decision Making : An executive who makes decisions can always

get things done. He has to get and make decisions for making other people do their jobs. An executive's ability to make decisions, of course, depends upon the authority given to him by his superiors.

Drive : He gets things started and keeps them moving. His project will not collapse after a quick beginning if he stays with them until the final destination is reached.

The problem of discovering and applying principles of leadership is made complicated by three facts:

1. The search for principles is itself a difficult task on which only a beginning has been made.

2. The laws operating in any real situation are probably complex and numerous, so that the net effect of any one principle is not always dominant or clear.

3. There are large elements of skill in the application of leadership principles. The response of a person or an organization to a leader's action will depend on how the leader carries out his intentions as well as on the principles that guide his effort.

To illustrate what is meant by an established principle of leadership, three principles are given below together with some illustrative research data :

(a) Employees are likely to be more productive and have higher morale under general supervision than under close supervision.

(b) Employees-centered supervision is likely to result in higher productivity than is production-centered supervision.

(c) The performance of a subordinate depends in part upon the degree to which he becomes a member of a work group which is characterized by group pride, cohesiveness, solidarity.

Human Relations : Neglect of human relations is the greatest drawback of an executive who possesses a number of other qualities that make an efficient executive. He must clearly under-

stand that he achieves all his objectives through the people he works with, the people who work for him, and the people he works for. He must build social relationships with these people.

Communication : An executive must acquire and develop oral and written communication skills. Telling people what they need to know in ways they clearly understand is one-half of your communication and listening is the other half. Talent and self expression is necessary in every phase of the executive's job. The function of executives are "first, to provide the system of communication; secondly, to promote the securing of essential efforts; and third, to formulate and to define purpose".

According to the periodical "Computers and Automation" June 1969, vol. 18. No. 6, in article "Leadership in Changing Society", the importance of communication is, "Communication is undergoing revolution today as great as that occurring in energy .... intellectual attainment of the highest order will be required for leadership in such a situation".

If our ability to draw upon the information created by those who went before us is a uniquely human characteristic, the communication, which includes important elements of education, is close to being the essence of humanism.

Imagination : New ideas must come to him and they must be expressed through him.

Personality : It is absolutely necessary because he has to work with his co-workers. Leadership is the personal relationship of one individual to others. Personality and its impact can make or break drive for success. To be a good leader, you have to be: 1. liked, 2. feared, 3. respected, 4. trusted, 5. admired.

Curiosity : Questioning must be part of an executive's nature and he must have tremendous thirst for answers.

Action : Unless and until he makes decisions and asks, he cannot expect his subordinate to ask.

Brains : He must have sharp intelligence and brain power which

possesses quality, quick thinking. He must be mentally alert; decisive and logical. His memory must be associative, retentive.

Skills : An executive must have broad knowledge of his job and responsibilities. He must be in a position to speak with authority and experience and knowledge.

Selflessness : It is an important quality of a good leader.

Planning : The space programme seems the most obviously successful example of systems planning - and it is systems planning which will be required of America's leaders in ever-increasing application for the future. "We must develop new managerial techniques and new organizational forms", said Sarnoff.

The Nature of Planning

1. Considering the purpose, objective or mission to be accomplished;

2. Determining what can be done to achieve purpose, objective or mission, and, in how much time; and

3. Choosing the most effective and feasible action to be taken.

There are more qualities of leaders which are given below: Self-analysis, training subordinates, judgement, delegation, positive thinking, loyalty, performance, reduce paperwork, reporting, fact to face dealing and skilful dealing with co-executives.

Business leadership especially will require as great intellectual subtlety as political or academic leadership, for the businessman must henceforth move in a broader world. In fact, only to the degree that the status and involvement of business leadership are upgraded, will any economy based on free enterprise prosper. In managing for effectiveness, a leader must be able to diagnose his own leader behaviour in light of his environment. Some of the variables which he should examine include his subordinates, superiors, associates, job demands and the organizational setting. This list is not all-inclusive, but contains interacting

components which tend to be important to a leader in most organizational setting:

He must be able to obtain the following objectives :

1. To raise the level of employee's motivation.
2. To increase the readiness of subordinates to accept change.
3. To improve the quality of all managerial decision.
4. To develop team work and morale.
5. To further the individual development of employees.

Conclusion

Until recently, only a relatively few experts in government, industry, business, labour and universities worried much about productivity. But the deteriorating position of U.S. in the world market and the slow pace of our economy have posed great challenges before the present-day manager.

National Commission on Productivity

Creation of this commission on productivity by President Nixon in June, 1970, to focus national productivity improvement to the quality and position of the United States in world trade, is a very encouraging step. This commission is composed of top-level representatives of business, labour, the public and government.

The commission is called upon to undertake a much expanded programme including research, field, and public information activity to foster productivity growth.

The image of the modern manager is a changed one compared to his counterpart only a decade ago, because he has to involve himself with the productivity problem also today on a priority basis. Dr. Nakanishi, Managing Director of the Japan Productivity Center is correct when he says, "In order to cope with the problem of human alienation, we must

endeavour to respect the dignity of each individual in an organization and to identify his goals with those of the organization. At this stage of progress, it is, hence, important that we add the principles of participation, fair distribution of productivity gains, and proper delegation of authority to the productivity movement."[3]

In essence, manager has to play the role of a leader in the area of productivity movement if this country still wants to claim itself one of the most efficient industrial nations of the world.

Secretary of Commerce and Chairman National Commission on Productivity, Mr. Peter G. Peterson, has said in a recent interview, "Each 0.1% gain in the nation's real output translates into an additional $1 Billion in real resources."[4]

3. Productivity & the Global Market—Plant Operating Management, May, 1972.
4. The Challenge: Increasing Productivity—Plant Operating Management, May 1972.

organise car routes on a voluntary basis.

(iv) All heavy vehicles, like jeeps, should be banned in cities. Further, Government should ban use of all vehicles developing more than 70 B.H.P. because they give a mileage of less than 6 kms./litre.

(v) A strict and vigorous enforcement of speed restriction and lowering the speed limit by 10 kms. per hour would save a sizeable amount of fuel.

(vi) Cities and towns having round about routes, to regulate

Document

The present energy crisis is though a global phenomenon, its impact is being felt more and more by the developing countries since most of them meet their requirements of 'liquid energy' from imports. It will be naive, however to say that the present crisis is a passing phase and would soon be over once the oil-rich nations revert themselves from the politics of crude oil to the economics of crude oil. On the contrary, this crisis has brought to the fore the ever-creeping imbalance which the Indian economy had been experien-

traffic, must be removed and more scientific flow patterns evolved.

(vii) It has been established through studies that proper inflation of tyres would save about 150 litres of petrol per year per car and proper tuning would save 225 litres of petrol per year per car. These figures should emphasise the necessity for a country-wide campaign on the need for proper tuning of the automobile. Such a campaign should be carried on by Indian Oil Corporation, manufacturers of automobiles and automobile components, Automobile Associations, etc. It means that 10 to 15 percent of petrol could be saved or, alternatively, 15 to 20 percent extra kilometers out of the same litre of petrol could be got if the car is properly tuned. Further, proper driving habit of the car also saves fuel. With these things in view, the following measures may be initiated :

(a) Films Division to produce a documentary film on how to keep one's car properly tuned and how to drive the car in a correct manner and this film should be given the widest possible publicity.

(b) A nation-wide training programme in the proper and scientific method of tuning cars for unemployed engineers, garage foremen and others should be conducted within the next 3-4 months by Indian Oil Corporation in cooperation with NPC, Indian Institute of Petroleum, Indian Institutes of Technology, Indian Institute of Science and Regional Engineering Colleges and Polytechnics. All the retail outlets of Indian Oil Corporation should be persuaded or compelled to either employ a fully-trained engineer or mechanic in properly tuning the automobile or to offer a place in their petrol pumps for such self-employed persons to practise their trade. Loans with reasonable rate of interest should be advanced to such of those trained engineers and mechanics who want to assist car owners in properly tuning the vehicles, for purchase of simple instruments and tool kits required for tuning the cars.

(c) Manufacturers of carburettors should be asked to manufacture

only the smallest size of the main jet of the carburettor for spares and to manufacture new carburettors only with the smallest size jet installed. As a result of this there may be slight loss of power and accelerating capabilities of the vehicle, but there will be a net saving in petrol consumption.

(d) Octane value of the motor spirit should be increased from its present value of 79 to 83 so that manufacturers of automobiles may be asked to increase the compression ratio of their car engines correspondingly, which will result in a 10 percent fuel saving as a result of the increased ITTO-cycle efficiency.

(e) Almost a tonne of steel is used in the manufacture of an Indian car. There is a considerable scope of reducing the weight of the car by more extensive use of non-metallic materials like plastics etc. Manufacturers should be asked to build the car bodies out of fibre glass reinforced plastic, if it works to be economical. Since the volume of production of automobiles is quite low, manufacture of FRP car bodies can be feasible. A 15 to 20 percent saving of petrol can be expected on every car fitted with FRP body.

Action Plan for Saving Kerosene Fuel

(i) The working hours should be advanced by one hour. Assuming that 50 percent of the kerosene is used for lighting purpose, which are used in hurricane lanterns and wick-lamps, each of which is assumed to work for 4 hours a day in approximately 80 million households, the approximate savings on this works out to be about 0.26 million kilolitres per year. The savings on account of advancing the day light would be more in summer and autumn months than in winter.

(ii) The burning of kerosene in forging and heat treatment furnaces and boilers may be banned except where protection of atmosphere is necessary as in some cases like brightly drawn non-ferrous metals etc. and/or where low sulpher content is desired.

Action Plan for Saving Aviation Kerosene

It is suggested that the maximum cruising speed of the civilian jet aircrafts be brought down by 15 percent or so and also instructions be issued to pilots of aircrafts to use only one engine while proceeding to the take-off point on the runaway and similarly to shut off one engine soon after the aircraft has landed on the ground.

Action Plan to Reduce High-speed Diesel Oil

(i) About 15 to 20 percent of the diesel fuel can be saved easily, provided the maintenance practice of our vehicles is improved, which is not difficult. This is because the specific fuel consumption is so closely related to the maintenance effectiveness of a vehicle. Although it may take some time to make an impact, a beginning could be made by providing training in maintenance practice on an extensive scale. Polytechnics and I.T.Is. can undertake such training and the staff can be given the necessary orientation.

(ii) For all diesel driven vehicles a compulsory preventive maintenance schedule should be enforced. A time limit of 6 months from now can be given. Since majority of the vehicles are under road transport organisations in public sector, it should not be difficult to enforce this regulation. In particular all diesel-driven vehicles should conform to the following :

(a) Batteries should be in perfect order and self-starters should be in perfect condition.

(b) All fuel injectors should be ground after every 10,000 kms.

(c) All fuel injection pumps should be calibrated after every 40,000 kms. and all fuel filters be changed after every 20,000 kms.

Each vehicle must possess a certificate duly certified by a competent or recognised authority to the effect that the above-mentioned items of work have been carried out.

(iii) Notwithstanding what is mentioned in the last para above, after 6 months every diesel vehicle that is smoking heavily should be challaned on the spot and if the defect is not rectified within a reasonable period of time, it should be impounded and taken off the road. The traffic police in the country should be trained to assess the extent of smoke nuisance from diesel vehicles qualitatively according to the methods prescribed by Indian Institute of Petroleum or Indian Institute of Technology, Madras, so that they can take on-the-spot decisions about erring vehicles and challan them. The Motor Vehicles Act should be suitably amended to ban heavily smoking vehicles from plying on the roads.

(iv) Public road transport organisations should initiate studies immediately to make a more rational utilisation of their fleet. It has been pointed out by several authorities on transportation systems, that on the basis of network analysis, a system of rerouting and rescheduling of the buses could be worked out in such a way that in most of the cases the efficiency could be doubled even with the existing resources.

Action Plan to Save Fuel Oil

All the existing boiler and furnace operators should be trained in the proper method of preparation of fuel oil for burning to ensure its proper combustion. While operators of medium-sized boilers are supposed to possess boiler proficiency certificate by law, there is no such law for furnace operators. The Factories Act should be suitably amended to make it mandatory for all furnace operators to undergo training in efficient operation of furnaces to be conducted by Engineering Colleges, Polytechnics, NPC etc. Even boiler operators who possess boiler proficiency certificates should be trained once again in the efficiency aspects of boiler operations.

Action Plan to Save Coal

(i) As many boiler operators as possible should be trained in the efficient operation of coal-fired boilers during the next 6 months.

Alternatively, in order to have a multiplier effect, teachers in Engineering Colleges and Polytechnics should be trained in efficient boiler operation, so that they could in turn train a large number of boiler operators in the efficient operation of boilers. The training programme for the trainers should be organised by NPC's fuel efficiency service.

(ii) The most important factor affecting the efficiency of coal burning particularly in the solid bed form on the grates is the size of coal. Unless coal is properly sized and sieved according to the specifications for which it is meant, the efficiency of coal burning will be severely affected. Another very important factor which affects the combustion efficiency is fines (- 3mm size) in coal. Too much of fines in coal — say greater than 20 percent — reduces the combustion efficiency drastically. In fact, even if the quality of coal deteriorates, it does not affect combustion efficiency as much as fines in coal do.

It has been pointed out by Anglo-American Study team on productivity as early as 1952 that the use of double screened coal in locomotives reduces fuel consumption by as much as 20 percent. Though at present there are regulations in respect of coal size, this is conformed to only on paper. Consumers receive coal with lot of fines. Fines are a nuisance in burning, they cause fires in coal-yard and they contribute to heavy transit losses. Elimination of fines in coal will improve combustion efficiency and save avoidable wastages of coal. A national policy in respect of utilising fines must be evolved.

Fines should be separated from regular sized coal at the pitheads by installing screening equipment. Fines thus accumulated at the pithead should either be briquetted with a suitable organic binder or diverted to the pithead thermal power stations. By this a minimum of 15 percent of coal being presently burnt in major industries and the locomotives could be saved. This saving amounts to approximately 3.5 million tonnes of coal annually.

(iii) Most of the coal burning equipments do not have waste heat recovery equipment attached to them, as a result of which lot of avoidable wastage of heat is taking place to the atmosphere. Over the next 2 years or so, installation of waste heat recovery devices

should be made compulsory for all coal burning equipment, be they boilers or furnaces. A minimum of 10 percent saving is possible and the rate of return on investment on waste heat recovery devices is quite attractive.

Action Plan to Save Electricity

(i) By advancing the clock by one hour, it would enable us to save a minimum of 10 percent of the lighting in domestic and commercial sector, which amount to about 0.5 billion kilo watt hours.

(ii) After 11.00 p.m., every night only half the number of street lights may be kept burning, thus saving some power. Neon signs, and commercial advertising lights may be allowed to be switched on for only one hour everyday in the evenings. The use of fluorescent tube lights for street lighting should be encouraged.

(iii) In order to discourage conspicuous consumption of electricity, special tariffs for electricity for use of air-conditioners, cinema houses, public buildings, etc. may be thought of.

(iv) Electrical loads of very low power factories should be disconnected altogether instead of imposing a penalty as is done at present by some electricity boards after initial warning.

(v) A stricter control and vigilance over distribution of electricity should be exercised, because theft of electricity robs the electricity boards of their legitimate revenues. The loss on account of theft of electricity along with transmission losses are as high as 16-18 percent.

Our commercial energy requirements are met by coal, petroleum and hydro-electricity. While we should make efforts to save avoidable wastage of all forms of energy, we should make special efforts to achieve substantial savings in petroleum, the bulk of which is imported at an enormous cost to the nation. Some actions at national level which are common to all types of fuels are detailed below :

(i) The year 1974 should be declared a "Fuel Efficiency Year".

comfortable in accepting without much data or analysis, the author's opinion that "one of the greatest tragedies in the economic annals of India is the alienation of the people and the government from the business class immediately after the Second World War" (p. 12). The reasons advanced are two : Firstly, the malpractices of a number of big business, and secondly the increase in industrial disputes on account of the failure of management to take note of the changes in the aspirations or expectations of workers for wages and better working conditions etc. While there is some truth in these arguments, it seems that the major factor, i. e. the economic situation, has not been given due weightage. This seems to be an over-simplification of the developing economic phenomena which overtook most of the developing countries of the world after the Second World War. Perhaps, it would have been better had there been more detailed statistical facts and analysis to support the authors' generalisations about the emerging trends. However, some of these chapters provide valuable insights into the issues, and are well documented. One, however, cannot help feeling a little perturbed why topics as the 'Role of Management Consultants' and the 'Mobility of Managerial Personnel in the Public-Sector' have been clubbed together.

Part II of the book which deals with the executive and supervisory development programmes run by different universities and institutions in India, seems a more painstakingly compiled section, which tries to collate and present valuable information. With the issues outlined in this section becoming increasingly important with the rapid industrial development in this country, and the growing need for supervisory and managerial training, practitioners should welcome a reference source that brings together much relevant, although scattered, information at one place.

Prof. Das Gupta has done an admirable job of surveying the complex subject of executive and supervisory development programmes. Beginning with an overview of the case for executive development in India, this section is broken into 7 chapters on the nature and scope of executive development programmes, in-Company Programmes, National Agencies and University Programmes. There is a separate chapter on Supervisory Training Programmes. This section is dealt

Part III, entitled "Professional Managers and Managerial Revolution", contains four chapters : one dealing with 'the concept of Professional Managers'; the second envisages 'the Concept of Managerial Revolution'; the third tries to identify some of the 'trends towards managerial revolution in India' and the last tries to assess the 'government and business relationship'. This part outlines some theoretical concepts about professional management and a managerial revolution. The papers are well documented. The author has ably summarised the findings of social scientists and management experts, and it is interesting to note that he has tried to point out that there is a growing trend towards a managerial revolution in India in both the public and private sectors of business and industry. To quote :

> "The efforts of the management in both the sectors of business poignantly discloses the fact that the process of managerial revolution in India will reach the highest point when the employers and employees iron out their differences in an atmosphere of democracy. In the managerial revolution in India, there is no class struggle between owner-managers and employee-managers. If at all, it is a conflict between two styles of management—authoritarian and democratic" (p. 266).

While one may not disagree with the author's views, one may have doubts whether such an ideal point—when the employers and the employees iron out all their differences—is likely to be reached.

The last chapter deals with Government and business relationship, where some sweeping generalisations have been made—e.g., 'business has complete faith in the ideologies of government', and the 'government has no distrust against business in private sector'—without defining the ideology or what type of businesses are being referred

due to the tunnel vision of its officials and not on account of being anything basically wrong with the ideologies and policies of the government". (p. 279-280).

One can only hope to share the pious optimism, if one has concrete evidence behind such observations.

On the whole, although it is well-written and documented, one finds it difficult to trace a continuing theme flowing through the book. Further, even though the papers contain valuable insights and point toward new directions for more research, yet a uniform organisational framework for presentation of diverse topics does not present itself, and one gets a feeling that it may be more akin to a book of readings. The book is a welcome addition to the growing corpus of literature on Management Topics in India, and shall be useful to students and managers alike.

A Management System for the Seventies

John Argenti

George Allen & Unwin Ltd., London (Available in India from Blackie & Son Ltd., 103/5 Walchand Hirachand Marg, Bombay-1), pp. 254, £ 4.00.

Reviewed by Rakesh Kumar*

John Argenti's book titled, 'A Management System for the Seventies' offers solutions to the management problems of today and tomorrow. It predicts the various problems managers will be facing during seventies. The book is not another theory of management, instead, it is a down-to-earth practical step-by-step system of management. It identifies just what managers should do and how they should do it over the next few years to ensure that the organisation they work for continues to be efficient in spite of the trend that management is becoming every day a more difficult and intricate task. Management system for the seventies has been built up in three main stages. First of all five essential components of management have been recognised. This simplest

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possible system has been called MS_0 (Management System-zero). In the second stage trends in the Seventies have been described. Fifteen major trends in science, in technology, in economics and in politics that will have major bearing on how managers would manage during the Seventies, have been identified. The study of these trends is an eye-opener for the readers in management. In the third stage, effect of these trends on each of the five components of management has been examined. At this juncture, a reader feels convinced that there is need to modify the management system MS_0. Mr. Argenti introduces here the modification in steps and calls the new management system MS70. This system is valid for all levels of management in all types of organisations and contains all the important factors that will spell the difference between success or failure in management over the Seventies. The book is presented systematically. Care has been taken to present the material in a lucid manner without inflicting any monotony on the reader. The author writes with clarity and in a simple style. The book is a *must* for enlightened managers and students of management to overcome the obstacles during the Seventies.

Efficiency and Audit of Public Enterprises in India

Laxmi Narain

Orient Longman Ltd., New Delhi, 1972, Rs. 32.00

Reviewed by Anonymous

This study has been sponsored by the Research Programmes Committee of the Planning Commission. It successfully attempts to break new grounds as far as efficiency audit of public enterprises is concerned. It is necessary to mention here that this is the only book yet published anywhere on the subject. As a poineering attempt, the study has several qualities. It is thoroughgoing, objective and analytical. But it suffers from certain important limitations. The author acknowledges the existence of many complex and diverse factors that affect efficiency of public sector units. He also acknowledges that these are not always easy to quantify. His adoption of the studies by the Comptroller and

Auditor General of India for the purpose of scrutiny is, therefore, understandable. However, this study would have lived better up to expectations if the CAG's efficiency audit functions were appraised from the standpoint of individual public sector units, the kind of trends noticed in efficiency and the assessment made by the CAG with particular reference to any inconsistencies between them. Instead, the data discussed in the study are primarily those available in CAG's audit reports.

It is well known that the public enterprises suffer from many constraints. Also well known is that these units are not commercial-oriented. However, the way and the extent to which non-commercial orientation influences the commercial working of these enterprises has not been charted out in the study. Thus, it is easy for the public sector units to fall back on non-commercial motives when they fail to show commercial results. This is, however, only one part of the story. The other relates to the norms of efficiency that one notices in different facets of working in these enterprises in the public sector. There are more efficient and less efficient units from the overall point of view. However, some less efficient units may have particular aspects of their working efficiently which, even more efficient units could follow with benefit. Efficiency audit conducted by the CAG has religiously thrown up pointers to this effect since 1963 when the Audit Report Commercial started appearing as a separate volume. The lessons drawn from them, either by the enterprises themselves or by the Government, have been very indifferent indeed and one notices the same type of pointers being thrown up from year to year.

The author also does not acknowledge the process of metamorphosis through which the exercise of audit has been passing even before the recommendations of the Administrative Reforms Commission. From routine fault-finding, the audit report has already become a professional appraisal of performance. But the author does not appreciate this particular point of view and goes on to suggest that audit should not be fault-finding and that shortcomings should be judged in the context of the situation in which they have arisen. These are all true but when shortcomings pointed out are ignored by the enterprises, which in fact are meant for their own benefit, one cannot but look askance at the standpoint of the enterprises and the peculiar defence that they try to put up. Moreover, in the context of efficiency or performance audit, one should not underrate the importance of the traditional role of audit,

particularly with respect to the type of shortcomings noticed in different audit reports, such as overspending, underrecovery, overpayment, etc. From this point of view, efficiency audit or performance audit cannot substitute propriety audit in the context of scarcity of resources through which the country has been passing. The public sector has been a major recipient of these resources and it is on its performance that resource-generation in several key sectors of the economy would depend. In the circumstances, such drainage of funds into unproductive and wasteful channels should not be allowed to continue at least without comments from the CAG.

These criticisms, however, do not detract from the value of the book which should be read with interest by students of industrial and public economics.

Labour and the American Community

Derek C. Bok
John T. Dunlop

Affiliated East-West Press Pvt. Ltd, New Delhi, 1974, pp. 542, Rs. 15.00

Reviewed by V. K. Goel*

Over the last two decades, there has been a continuous flow of literature on trade unionism—both in the developed and the developing nations. Most of them, however, view trade unions as an interest group rather than a socio-economic institution. The 'interest-group approach' not only brings a certain amount of subjectivity into their analysis, but also colours the judgment which they pass on trade unions. It is in this context that the "Labour and the American Community" written by two eminent labour economists of the world is a refreshing deviation. An outcome of a detailed study undertaken by the authors under the auspices of the Special Studies Project of the Rockefeller Brothers Fund, the study can more appropriately be regarded as a text book on "Sociology

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of Trade Unions", irrespective that it primarily deals with Trade Unionism in the American soil.

The study begins with a sketch of the opinions held by the public and several major sub-groups about the trade unions. Interestingly, in spite of the fact that America is one of those countries where the trade union movement is strongest, trade unions are still among the least understood of socio-economic institutions. In the first place, an average American, and for that matter people everywhere, view trade unions as an extra-societal institution meaning thereby that it should be free from the weaknesses with which the society at large suffers. For example, while an American would vote for curbing the trade union power, he is indecisive when it comes to the power of multinational corporations. Similarly, people by and large accept the workers' right to organise, but are reluctant to accept the 'right to strike' which is, in fact, only the other side of the same coin. The study highlights many such ambiguities and ambivalencies in thinking of people when it comes to trade-unionism.

Starting from the opinion survey, the study covers the whole gamut of interrelationships between unions and members, union and management and unions and the community. The whole analysis of this multiple social interaction and the inferences drawn therefrom have many valid points not only for the unions, employers and governments of the developed world, but also for their counterparts in the third world. In particular, it helps the governments of the developing countries to solve their dilemma as to whether unions are worth having. To the trade unions of the developing countries like India, it has even a greater value since it attempts to tell them, through what appears to be the prescriptions for American labour, how can they avoid excessive government control on collective bargaining, how to maintain and increase the importance of the union to its members, how to develop the required knowledge and talent to meet the challenges ahead, how to develop an organisational structure to meet these challenges and so on. It should be presumed that once a government understands, the necessity of trade unions and trade unions undergo the above process of their development, the attitude of employers would no longer be a problem. In short, the study provides all those who are concerned with trade unions and trade-unionism with a fresh approach to look at the unions in contemporary societies as also a new perspective with which to look at a number of stubborn problems that are inherent in trade unionism.

Indian Labour : Problems and Prospects

V.B. Karnik

Minerva Associates, Calcutta, 1974, pp. 286, Rs. 39.00.

Reviewed by V. S. Mahajan*

It is well recognised that labour plays a pivotal role in economic development. A healthy, contented, dedicated and well-disciplined labour force helps promoting rapid industrialisation. On the contrary, a discontented, dissatisfied and undernourished labour force retards economic development. Therefore, there is little conflict between growth and distribution ; for if fruits of development are not shared by those who play a pivotal role in this process, we would be facing a discontented and undernourished labour force not in a position to promote growth. However, without a concerted effort in a capitalist or semi-capitalist (or partially socialistic) economy labour is unlikely to get its due share in the national product. It is here that trade union movement assumes special importance. It is through such a concerted action that workers would get justice. At the same time too much unionisation would be as much damaging to growth rate as under-unionised labour.

The book under review is written by a veteran trade union leader Shri Karnik and contains articles and papers written by him in Sixties and Seventies. The author covers practically all aspects of trade union movement in India. He starts with tracing out factors behind its slow growth in the past and how the British Government looked down with suspicion on such a movement and employers—quite a large number among them being British—were equally not reconciled to the growth of such a movement. Then he spells out the role played by lawyers, doctors and members from other professions in promoting the image of trade union movement in its early stages, especially at a time when workers were completely ignorant of this movement. There are a couple of write-ups on the attitude of communists to trade union movement.

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"The only thing that interested them (communists in the late Twenties) was revolution which they thought, was just round the corner. In the name of that imaginary and illusive goal, they harried workers from one demonstration into other. Workers revolted against this Communist Policy of constant and perpetual struggle and left them and their Unions". (pp. 126-27).

During the inter-war period (1919-39) under the leadership of political leaders like Gandhiji, Dinabandhu Andrew and others, the trade union movement made a rapid progress ; and the British Government had duly recognised this fact when it rushed through legislation recognising trade unions and providing various welfare facilities to workers under the Indian Labour Acts. Dinabandhu Andrew, a foreign missionary and a close associate of Gandhiji, had played an important role in encouraging the growth of trade union movement, especially among railway workers. Mahatma Gandhi had concentrated his attention on textile workers of Ahmedabad, and "looked upon the Textile Labour Association of Ahmedabad as a laboratory for his work amongst labourers". (p. 139). The Textile Labour Association was an ideal association of workers which earned high reputation even among the foreigners. Gandhiji also developed the idea of Trusteeship in business which suggested that employers should not regard themselves as owners of means of production, but mere trustees, and take the amount out of profits just sufficient for their maintenance, and rest should be spent for alleviating economic status of workers and for general social welfare.

There are articles devoted to the post-war (or recent) growth of trade union movement in India. The author has laid particular stress on the growth of unions among the white collared employees (including officers) in Government departments, public sector undertakings, banks, insurance companies etc., a thing practically unknown in the pre-war period. The author also focusses on strikes by Central Government employees, recommendations of the Third Pay Commission and National Labour Commission, unionisation among women workers and their service conditions—just to name a few topics.

The book would be found extremely useful for all those interested in the labour movement in India and particularly by students of Indian labour problems. The book is well written and adequately supported by facts and figures. One, however, feels that the price is rather very high.

Development Administration in India

Edited by V. A. Pai Panandiker

The Macmillan Co. India Ltd., Delhi, 1974, pp. 238, Rs 75.00.

Reviewed by C. V. Rao*

The absence of suitable systems and methods to translate the programmes included in the Five-Year Plans into concrete operational activities with utmost economy of time and resources calls for a review of development administration. The very focus on and concern with development administration has compelled the development of a system of thought capable of integrating complex socio-economic and political systems, operating in hitherto forbidden areas of public administration.

The traditional theory of administration with its own limitations, needs a change. The nucleus of the new theory of development administration lies in its capacity to bring about an agrument between the programmes designed to change the structure and behaviour of the various institutions, to develop an acceptance for change, and to conduct the various activities to sustain and support the objectives.

With these in the background, conceptual and operational level problems are dealt with in this book. Distributed over a dozen chapters, it deals with a number of problems regarding development administration. Mr. Sen's article, "Formulation of the National Plan—The Basic Process and the Machinery", deals with the complex processes involved in entire planning and problems associated with it. Articles of particular interest are by M/s. Pai Panandiker and Kitchlu in chapters IV and V respectively. Mr. Panandiker views that in a planned economy like ours, a discrete programme becomes the crucial instrument for translating the plan into a set of concrete action. In addition, it focusses on the lack of planning and more so its management in India. Mr. Kitchlu, in chapter V points out the lacunae in the present system of project management and their remedies.

Further, articles by M/s. E.R.K. Menon and M.J.K. Thavaraj which

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concentrate on Financial Control and Performance Budgeting in India, assert that the present system of financial control is not very effective and this can be done only by performance budgeting and implemented through proper management.

Finally, the article by Mr. Khosla, is a timely one, wherein problems of research and the need for research in development administration are discussed in detail.

It is high time that a serious thought be given to this problem of development administration. Being the first book of its kind in India, it can help a professional administrator and serve as a guideline to a student.

Wage Incentives : Theory and Practice

Ed. G.K. Suri,

Sri Ram Centre for Industrial Relations and Human Resources, New Delhi, 1973, pp. 231.

Incentive Systems in Sales Organisations

G.K Suri,

SRC. New Delhi, 1973 pp. vii+131.

Reviewed by G.R.S. Rao*

Incentive systems are increasingly being adopted in the developing countries and argued for as a means to promote productivity. Although the main objective of the wide range of incentive schemes is increased production, there are other equally important aims such as improvement in quality and safety and reduction in waste and absenteeism etc. The efficacy of any incentive scheme largely depends upon several contextual features such as an effective managerial organization, an equitable wage structure, and structure of the labour force and industrial relations. It

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is the multiplicity of the incentive systems and the complexity of contextual factors within which incentives operate that offer a challenge to the managers in designing appropriate and effective incentives in the developing countries.

It is in this context that the two volumes under review provide a welcome addition to the literature on the subject.

The value of the edited volume lies in that it essentially provides a conceptual and theoretical treatment of the subject in the Indian socio-economic context and covers issues such as wage incentives vis a vis productivity, motivation, behavioural processes, organizational effectiveness, social implications, supervisory compensation, management prerogatives and alternative payment methods. The treatise also deals with the problem from the standpoint of law, unions, managements and academic viewpoint in the Indian context and specifically deals with the problems and prospects of wage incentives in the building industry in India. A six-page select bibliography provides a good supplementary reading, although some of the significant empirical work have not been taken note of.

The volume starts with an in-depth examination of the problems and prospects of wage incentives on the one hand and an analysis of the concepts such as motivation and productivity in relation to incentives—not only for workers but for several categories including office staff, supervisors and executives. The potential of incentive schemes to play a diversified role of motivators of workers, monitors of human resource utilization and mechanism of industrial productivity has been appropriately brought out as one of the issues in the area of man-management in the Seventies.

Sheth's paper on Social implications of wage Incentive Schemes (pp 107-124) discusses the problem of incentives at the micro-level and yet very happily integrates a wide range of sociological factors that influence the functioning of incentives. Other papers deal with various specific aspects of the problem. Yet all of them, very truly, suggest that incentive systems operate within the framework and are influenced by the structure of industrial relations at the macro-level, which in India is characterised by managements' concern for productivity and linking up wages with productivity, workers' (and unions') primary insistence on

minimum (living wages) before production and productivity could be talked about and the dilemmas before the Government in relation to the industrial relations policy and problems. Hence, treatment of the problem of incentives in the Indian Context at the macro-level would have been very rewarding and useful for policy makers.

The critical summing up by the editor brings out the entire range of incentives alongwith their pros and cons and the situational characteristics favouring their use.

The second volume is based on empirical data drawn from sales organisations and proves a useful complimentary work on incentives.

All said and done about incentive systems, the volume under review underlines a significant fact that "little empirical work has been done on the results of profit sharing" thus pointing to the need for research in this direction. Unfortunately in India, there is a woeful lack of data in this area. Before various incentive schemes get fixed up in ideological and *interest fixtures*, the impact of various systems of incentives in divergent industrial relations situations need to be empirically analysed.

A limitation that often shows up in a volume of this type, composed of papers written by various authors at different times and for different purposes, becomes evident on p. 59.

The volume is richer in its theoretical and conceptual content than in empirical data, although this was aimed "at satisfying the need for a data based publication in this area". A publication of such a major coverage would be expected, normally, to take note of publications based on empirical studies (covering as many as 50 industries in India) that preceeded it.

Also in a work of this nature which sought to analyse the problem of incentives in the Indian context, coverage of the impact of major market constraints such as shortages of raw material (including power, water etc.) on incentive systems would have proved appropriate and useful.

New Books : Annotated List*

Pricing and Investment in Public Enterprises

New Delhi, Oxford & IBH, 1974, pp. 342, Rs. 35.00.

This book is an outcome of the Seminars held by the Institute of Public Enterprise at Bangalore in September 1969 and January 1970. It contains the discussion papers by scholars and senior executives, dealing with the crucial aspects of the working of public enterprises in India such as accumulated deficits, debt, equity ratio, pricing, township outlays and investment, concept of a public enterprise commission and capitalisation. In addition, it analyses the multifarious problems faced by public enterprises and constraints operating on their working.

Indian Labour Laws : A Supervisor Should Know

R.B. Seth.

New Delhi, All India Management Association, 1974, pp. 78, Rs. 8.00.

Considering the rapid industrial development that has taken place in our country, knowledge of labour laws for supervisory and junior executives is of vital need since they are the backbone of our industry. They are the vital links in the chain of management and their main job is to give effect to the plans and policies of management.

An attempt has been made in this book to give supervisors a basic understanding of labour laws. It covers eight enactments relating to industrial relations, working conditions, etc. They are :

1. The Factories Act (1948);
2. The Industrial Disputes Act (1947);
3. The Industrial Employment—Standing Order (1946);
4. The Indian Trade Unions Act (1926);
5. The Minimum Wages Act (1948);

* Prepared by H.N.D. Gandhi, Librarian & Documentation Officer, National Productivity Council, New Delhi.

6. The Payment of Wages Act (1936);
7. The Payment of Bonus Act (1965); and
8. The Contract Labour—Regulation and Labour (1970).

Training and Development in Government

A.P. Saxena

New Delhi. The Indian Institute of Public Administration, 1974, pp. 198, Rs. 12.00.

Provides material on training of trainers, types of training, on-the-job training, training in Government and some problems in post-training utilization of trainees. The emphasis is on the training of the middle level administrators. The author discusses briefly the salient features of training in Government today and highlights the need and importance of training programmes for public administrators.

At the end of each chapter references/notes are given that make the publication more useful. A selective bibliography is also given.

Price Trends and Policies in India

A.B. Ghosh

Delhi, Vikas Publishing House, pp. 254, Rs. 35.00.

Galloping rise in prices in general, has put the Indian Economy in a tight corner. This book attempts to explain the rise in the tempo of prices in India between 1951-73. The first three chapters deal with the scope of price policy and some theoretical aspects of price control. Price trends during the Five-Year Plans are analysed at general price level, the sectional price levels, and the prices of a few individual commodities. The author has suggested some measures for the prices of individual commodities and of the economy as a whole, keeping in view the characteristics of developing economy of India.

Black money and monetary policy are dealt with in the Appendices. The book contains statistical statements and bibliography of books and reports at the end.

Financial Planning in the Indian Public Sector —A Management Approach

B.S. Sharma

Delhi, Vikas Publishing House, 1974, pp. 212, Rs. 35.00.

Problems and processes relating to the financial planning system in the public sector projects in India are dealt with in the book. It is divided into three parts :

1. Analytical framework of financial planning ;
2. Financial planning in public sector projects in operating and expansion periods ; and
3. Concluding remarks.

Planning and the Poor

B.S. Minhas

Delhi, S. Chand & Co., 1974. pp. 141, Rs. 25.00.

Consists of four essays written at different times between June 1969 and March 1973. Broadly, Chapter I traces the evolution of objectives and strategies of planning in the Nehru era, followed by a critical appraisal of the Fourth Plan. Chapter II, an outcome of a seminar held in New Delhi in May 1970, brings out the fact of moral poverty to the forefront, role of land reforms and suggestions to reduce poverty. Issues discussed in a seminar (organised by Indian Society of Agricultural Economics) held in October 1972 at Ahmedabad on Rural Development are summarised in Chapter III. The IV Chapter, in the form of a convocation address at Punjabi Agricultural University, Ludhiana, in March 1973, epitomises the dire consequences of monetary and fiscal policies leading to inflation.

A note on the non-feasibility of Draft Fifth Plan, and its inconsistency with the objectives of "removal of poverty and attainment of self-reliance" is appended at the end.

Regional Development Planning in India—A New Strategy

R. P. Misra, K. V. Sundaram and V. L. S. Parkasa Rao

Delhi, Vikas Publishing House, 1974, pp. 398, Rs. 55.00.

The question of equity—social and aspatia—has now come to the fore-front in our development policy. Greater emphasis is being laid on achieving a balanced regional development and therefore planning has to be responsive to the emerging problems of the society at various territorial levels.

The book, spreading over a dozen chapters, reviews the planning process, shedding light on regional imbalances, their assessment and policies to solve them. A theoretical framework (a new strategy) is dealt with in chapters 6 and 7, followed by an operational strategy in chapters 8-11. Finally, the last chapter deals with the implications of the new strategy. A selected bibliography is given at the end.

Economic Growth and Technological Change in India

Bipin Behari

Delhi, Vikas Publishing House, 1974, pp. 224, Rs 40.00.

Technological change is important for economic development and the Five-Year Plans of India have laid much emphasis on it. The present book is in continuation of the author's earlier work "Gandhian Economic Philosophy" where the approach to technology and social objectives were discussed. This book deals with the emerging economic problems of the country—mainly arising from new impulses in agricultural and industrial development, resulting in sociological changes. The author suggests that the various problems can be identified and a suitable technology developed. The book contains a bibliography also.

A Critique of The Critique

A.M. Khusro (India's Economic Policy : A Critique and An Approach, Productivity, Vol. XV, No. 1, pp. 17-36) seems to argue out an ideal case for the 'controlmanship' to be supported by well-informed 'economic expertise'. In his own words ". . . . . since nonexpert controls do not work, what actually works is the market mechanism ! In the result, instead of controlling the market the controlman turns out to have been controlled by the market and black marketeers. . . . . that economic policy in this country is not informed by economic theory but only by a non-expert general wisdom. . . . . ." (pp 19-20).

There is a contradiction in the critique—a basic contradiction which makes the critique analytically weak. It is maintained that ". . . . . what makes non-sense of price mechanism is basically (1) the maldistribution of income or purchasing power and (2) the existence of monopoly/oligopoly" (p 19), whereas the prescription, according to the critique, calls for setting up technical cells "to estimate. . . . . .the relevant commodity-wise elasticities of demand and supply with respect *to income* and *price*" (p.32 Italics supplied). If, as the critique has admitted, the market mechanism has already been made a non-sense by the maldistribution of income and by the existence of oligopoly/monopoly, what could be the analytical use of these income elasticities and demand elasticities, which themselves are based on data from such a market !

"If the price elasticity of demand (E_{pd}) is *small*, if the price elasticity of supply (E_{ps}) is *small*, if income elasticity of demand (E^{id}) is *small*, and if the income elasticity of supply (E^{is}) is *small*", price and quantity control of such commodities are advisable (p.32, Italics supplied). The expertise of the expert turned out to be conspicuous by not indicating "*how much small*" could these elasticities be for the given situation. Theoretically, they could be anywhere in between minus infinity and plus infinity ($-\infty \leqslant E_{pd} \leqslant O$, $O \leqslant E^{id} \leqslant \infty$, if the commodity is not inferior, $O \leqslant E_{ps} \leqslant \infty$, $O \leqslant E^{is} \leqslant \infty$). Usually, in welfare states like India, price and quantity controls are exercised only in the case of *essentials*, defined as those whose elasticities of demand with respect to both price and income are relatively smaller (generally $-1 \leqslant E_{pd} \leqslant O$, $O \leqslant E^{id} \leqslant 1$), in other words inelastic

ones. If the conclusions of the critique are accepted, it follows that the size of the resultant black market would not have been big enough to become "the enemy of socialism", which again contradicts with the critique.

The paper seems to attribute, the origin of black earnings to some such ill-conceived controls, and the growth of it to what is called the *propensity to evade tax* which is directly related to the prevailing tax rates. It implies that a reduction in the tax rates would result in less incentive for evasion. But in actual practice, the tendency to evade tax has its origin mostly in the economic gains from evasion and this would be positive and substantial for whatever tax rates above *zero,* provided that the *marginal monetary gains* from such evasions exceed the direct *monetary cost* of doing so, if any.

—N.K. Nair
New Delhi

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Century Rayon sets an example to other large corporations by its policy of synthesising service to the community, fulfilment of its obligations to the employees, the customers and the shareholders. And yet, you will be surprised, it is making the highest contribution to the national exchequer by way of tax payments as well as foreign exchange savings and earnings.

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b) by giving technical assistance, c) by helping them in marketing.

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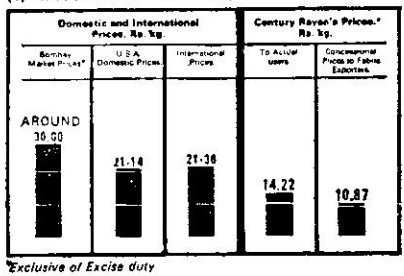
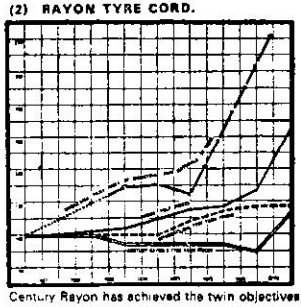


*Exclusive of Excise duty

Very rigidly adhering to the Voluntary agreement between Viscose Rayon Spinners and Weavers, Century Rayon is selling approximately 60% of its production directly to Actual Users at the low price of Rs. 14.22 per kg. and an additional 20% directly to exporters of Rayon Fabrics, at a substantially low price of Rs. 10.87 per kg.

(2) RAYON TYRE CORD.



Century Rayon has achieved the twin objectives of maintaining the price of Tyre Cord below the international level and supplying directly to Actual Users.

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To meet the needs of genuine users in the present acute shortage conditions, Century Chemicals is following a policy of supplying the entire production to Actual Users on the basis of first offtake, at fair prices.

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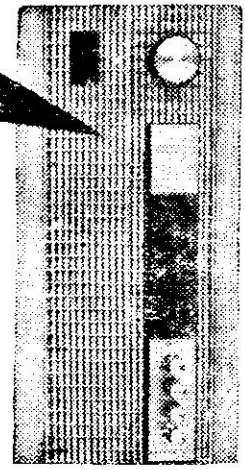

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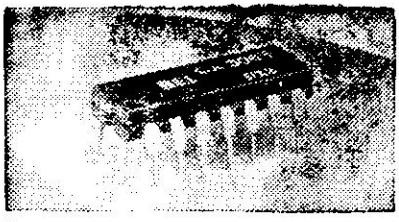

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