PRODUCTIVITY

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Humanism and the New Technologies

"The truly depressing thing about the Port Talbot strike is not so much the waste of shutting down this fine modern plant, or even the distress inflicted on thousands of families; it is the inability of both sides to the dispute to explain their cases to each other.

...There seems to be a positive barrier to communication, and not just in this dispute. Oddly enough I discussed this point with Lord Melchett, the Chairman of the British Steel Corporation, only a few weeks ago. **Industry, he argued, is prepared to spend millions of pounds developing new technologies to create the maximum efficiency in its physical plant.** All this is taken for granted. But **virtually nothing is spent investigating the most important single element in the whole process of production—the human beings who operate it. We know everything about the machinery and the raw materials, very little about the attitudes of men and women who work them.** And we pay the cost of our ignorance in devastating strikes which reveal the futility of developing advanced technology without reference to humanity. The system, which has not changed in any essential respect since the Industrial Revolution, is increasingly crazy from a purely commercial viewpoint, for the cost of bad labour-relations rises *pari passu* with the level of investment. The Port Talbot affair, I read, has already lost the Corporation £4m. But would anyone dream of spending even one million to find out exactly how it arose and how it could have been avoided? No: that would be long-haired stuff."

PAUL JOHNSON in the *New Statesman*, 9 August 1969

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PRODUCTIVITY

NATIONAL PRODUCTIVITY COUNCIL JOURNAL

THE SOVEREIGNTY OF THE TECHNOSTRUCTURE

IN THE NEW INDUSTRIAL STATE—THE MOST ORIGINAL CONTRIBUTION TO POLITICAL ECONOMY since the publication of Keynes's *General Theory* in 1935—Prof. Galbraith poses the thesis that the real power in the modern economy vests in the amorphous groups of technocrats that at various operative levels control the functioning of Industry and Government; and in this what he calls the Technostructure, Capital Formation, Growth and Productivity, a consilience of the Public and Private Interest, an automatic and equitable sharing of the Gains of Productivity are, as it were, in-built.

The consequences of such a shift in power are only too apparent. Prof. Galbraith proves painfully with massive statistics and an incisively deep analysis of facts that the political arm of Government, the Trade Union Organisation, and entrepreneurial management count for less and less in the affairs of men; and the real content of decision-making has passed decisively into the hands of technocrats of Industry and Government; and political and trade union institutions and managements are for the most part ceremonial organisations, which have little option but to endorse the Group Decisions of the Technostructure.

And in this, the Private and the Public Sector act in harmony with due regard to the Public Interest. Ideology falls into the background under the overwhelming impact of Technology.

Productivity is no longer the problem in this Affluent Society. In fact, its Economics of gushing abundance threaten the basic values of civilised existence; and these can be reasserted positively by what Prof. Galbraith calls the Scientific and the Industrial Estate, establishing its autonomy from the dominance of the Technostructure.

And herein lies the rub, for the Technostructure draws for its strength on the Scientific and Educational Estate. In fact, it is itself the by-product of the massive doses of Science and Education that have been injected into the developed economies during and since the Second World War.

So far as the under-developed world is concerned, our problems still retain their intractability; and Productivity of the socio-economic structure remains the basic problem: in fact, it will, till we

are wise enough to make the same draft on the Gross National Product for Science and Education that Japan and the Soviet Union do—and mainland China has been doing for over two decades—and the Western Democracies for a much longer time.

For us, in the underdeveloped countries, the principal lesson of Prof. Galbraith's *New Industrial State* is that **Finance Capital is no longer the critical resource for growth: it is qualified manpower.** The principal handicap of this country is that both our men and managers are by and large technically ill-equipped for the tasks of a modern economy. **The fact is that there is hardly a Technostructure either in Government or in Industry. Our problem is not how to combat its assault on moral and aesthetic values, but to create the very basis of a structure with massive technical content.**

Of course, we shall have to face the political and social implications of the dwindling importance of formal governmental authority, the power of the trade unions and the old type entrepreneurs; these developments are coming to us, as they have come to the Western Democracies; and they will affect the structure of tripartite institutions whose framework is based on the assumptions that the reality of economic power still rests with organisations of employers and employees and Government, whereas even in our own country, technocrats have come to wield a far greater power than what they are apparently credited with.

Hence fundamentally, Prof. Galbraith is right in what is going to be the Shape of Things in India of the 1970s; but at the same time, we need to warn ourselves that the sequel to Prof. Galbraith's Industrial State is his *Affluent Society*, whose publication, in fact, preceded that of the *New Industrial State;* **and ours is not an Affluent Society: in fact, far from it.** While Prof. Galbraith's Industrial State poses a Moral Problem, ours is an essentially Economic Problem. We are not threatened with any surfeit of goods; and our problems are not that simple that they can be resolved through what Prof. Galbraith calls The Management of Aggregate Demand (an essentially Keynesian idea) or what we call here as Deficit Financing. Ours is essentially a Productivity Problem: the social economy has to be organised and energised, and men and women trained for higher levels of performance, practically at every point of the social structure.

Hence there is real danger, just as in the case of Keynes's *General Theory* that intellectuals, lured on to the ideas of the Affluent Society and the Power of the Technostructure, may not treat Prof. Galbraith's formula as the magic wand by which we can overnight create affluence in an underdeveloped economy. Such, in fact, is not Prof. Galbraith's intention, nor was it Keynes's, when he wrote : "....that of two equal communities, having the same technique but different stocks of capital, the community with smaller stock of capital may be able for the time being to enjoy a higher standard of living[1]....a poor community will be prone to consume by far the greater part of its output, so that a very modest measure of investment will be sufficient to provide full employment...."[2]

In fact, among the economists of the underdeveloped countries, an illusion was created that a high propensity to consume, and along with it, a high multiplier were such powerful instruments in the hands of the Government of a poor country, that all that it had to do to create Full Employment conditions, culminating, in fact, in some sort of a Garden of Eden, was to determine the direction of investment such as we do in our Planning in India, and regulate the rate of interest, whereas our main problem is the existence of structural rigidities in our socio-economic life, the weakness of the political and administrative framework as a basis for Planning, and the abnormally low productivity of the whole industrial and agricultural system.

[1]Keynes, JM : *The General Theory of Employment, Interest and Money*, Macmillan, 1960, p. 219.

[2]Ibid, p 31.

Prof. Galbraith's theory is that way more realistic, from our point of view, than Keynes's. In fact, The New Industrial State of Professor Galbraith is an extensively Planned State, where the Market Economy is decisively superseded by the Planned Decisions of the Technostructure. The Private Sector and the Public Sector do not pull in opposite directions. In fact, they are both integral parts of a well organised economic structure; and the whole system rests on a vastly expanded Public Sector :

> "Equally it is a commonplace that the relation of the State to the economy has changed. The services of Federal, State and local governments in the USA now account for between a fifth and a quarter of all economic activity. In 1929 it was about eight per cent. *This far exceeds the government share in such an avowedly socialist State as India,* considerably exceeds that in the anciently social democratic kingdoms of Sweden and Norway, and is not wholly incommensurate with the share in Poland, a Communist country[3]. (italics ours)

> The main dynamic factor of change, however, is Technology: "The innovations and alterations in economic life in the last seventy years, and more especially since the beginning of World War II, have, by any calculation, been great. The most visible has been the application of increasingly intricate and sophisticated technology to the production of things. Machines have replaced crude manpower. And increasingly, as they are used to instruct other machines, they replace the cruder forms of human intelligence."[4]

It is only when this process of Technological Advance gathers momentum in this country that we may in the distant future be plagued by the problems of affluence. As it is, even in respect of the doubling of the low per capita incomes in real terms—which was, two decades ago, the dream of the planners for the 1970s—the prospect has in fact receded. We do certainly require a lot more of philosophy and a lot more of art—Prof. Galbraith's antitoxins for the New Industrial State, but what we do immediately require is a lot more of breakthrough technologies, the wisdom and the courage to use them effectively and purposively in the service of the community, and an infinite lot more of productivity in the way we administer our affairs in Industry and Government. ●●●

[3]Galbraith, John Kenneth: *The New Industrial State*, p. 2.
[4]*Ibid*, p. 1.

Keynes on Indian Banking

Few people probably know that the late Lord Keynes whose economic theories created a revolution in economic science and policy in the thirties, made his debut in economics, with his book on Indian Currency and Finance in 1913. Later, even in Monetary Theory, it was Keynes who pointed out in his Treatise on Money that *bankers are not merely innocent recipients of people's deposits but they are active creators of money.*

However, in the context of things, it is Keynes's 1913 publication that now makes very interesting reading.

"Up to 1862 the Banks had the right of note issue... In 1862 the Management of the note issue was taken over by the Government... (p. 199.)

"...India, so far from being anomalous, is in the forefront of monetary progress. But in her banking arrangements...her position is anomalous; and she has much to learn from what is done elsewhere...(p. 259).

"...The...Section of the Indian Banking would comprise the Indian Joint Stock Banks i.e. those Banks other than the three Presidency Banks, registered in India and having their head offices there. This is a confusing group, because a great number of small moneylending establishments are registered as Banks under the Indian Companies Act. (p. 121)

"...Our interest in these Banks...arises not so much out of the banking business which they may possibly transact, as out of certain, almost Gilbertian characteristics calculated to bring the name and profession of banking into derision or disrepute..." (p. 230)

Time Study, Incentives And Productivity

Louis J Rago*

Because human performance tends to vary all over the lot, labour is the least dependable "production factor". This means that management must pay considerably greater attention to the labour cost factor than to the material or the overhead. Of course, this is only conceptual, since every cost factor is of equal importance as far as efficiency of an enterprise is concerned. Nevertheless, because of the difficulty to control human performance, the labour sector is singled out as the subject matter of this paper.

THE TROUBLE WITH LABOUR IS THAT IT IS "HUMAN", If the workers feel good during the day, their output tends to be higher than when they are troubled. Furthermore, the competence factor comes into play; not only that individuals have varying degrees of job skill, but they tend to perform at different working pace. Such differences between people and their performance make the *uniformity* of performance questionable. Yet uniformity of performance is an essential ingredient to production efficiency.

When performance depends on worker diligence and willingness to deliver a good day's work, then it is absolutely necessary to devise ways and means to control human performance. In a conveyorized production setup such control is not important, because the conveyor belt calls the tune—not the worker. But when the worker determines the **rate of production,** it is important to **guide the worker's performance with the help of ingenious managerial devices.**

Although good supervision is always an important factor in good performance, "slave-driving" techniques have certain limitations. Prosperous conditions, for instance, in the economy usually set limits how far management can push employees. Here **a self-policing device** —the wage incentive system—is needed. It is assumed that the wage incentive system "motivates" employees **from within,** whereas supervisory control over employee performance is considerd **exogenous** deriving its strength from fear, harassment and other unsavory supervisory techniques.

Industrial inefficiency can be traced to three major contributing factors: (1) equipment obsolescence, (2) lack of managerial skill and know-how, and (3) inadequate employee performance. That these three factors are inextricably interlaced goes without saying. But in this paper, attempt is made to deal merely with human performance *per se*, rather than with the other two factors.

Generally speaking, inefficiency, traceable to the worker himself, can be found in the attitude workers have toward their jobs and their employer on the one hand, and in job skill and competence on the other hand. Because the above factors require long-run remedies and cannot be changed overnight, **managerial**

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effort should be directed primarily toward getting the best mileage out of the employee's inherent abilities and present job skill. That in the long-run both his skill and attitude can be influenced is, of course, important. But the most important is to fit the worker and whatever skill and attitude he has into the job as fast as possible. Thus, what management can hope to accomplish in the short-run is to **shape and form the employee's behaviour on the job in the light of the current production requirements.** In this endeavour **employee complacency must be accepted as something natural with workers,* rather than base decisions on the ideal performance level.**

The Problem Must Be Localised

The interrelated causes for inefficiency must be segregated in order to avoid confusing the issues at hand. A man subservient to a conveyor belt cannot control production even if he wants to do so. Thus, a man working along an automobile assembly line cannot possibly hold up production by not mounting, say, a wheel on the car, for unless the wheel is placed on the car as required, the completed automobile cannot be driven off the assembly line. The nonconformist is bound to be fired. Management expects 100% performance. Loafing under a production-line type of operation is impossible.

But, not every plant is in such a fortunate situation. In most plants, the conveyor does not set the pace and the worker can easily withhold some of his "productivity". As a result, management can never be sure that the expected hourly output will be delivered or that the cost of production can be held within the budgetary allowance. That fluctuating performance would make production planning and control difficult goes without saying. In most production situations, it is the worker who determines productivity, because he has a great deal of control over performance.

Whereas conveyorized mass production is extremely successful in eliminating employee control over performance, in intermittent job shops it is still the worker who controls output and thereby has a significant influence on output, cost, and profit. Most plants tend to fall under the latter rather than the former category. Faced with undesirable worker attitudes, precipitating performance to fall short of expectations, management must do something to enhance the rate of output per manhour of labour. And, this is where incentive systems can play an important role.

Incentives—What Can They Do?

Barring conveyorized production lines similar to those mentioned earlier, both production planning and cost control are handicapped. Of course, mere knowledge of performance times does not assure results. Management may know precisely how long it should take to turn out, say, 100 units; but it is still questionable whether the employee is willing to deliver the said 100 units in time. Notice the difference: where there is no conveyor to force the worker to perform as required, nothing can make him perform. Sure enough, if a supervisor stands behind each worker, it is possible to get good results through a tight control over subordinates; but, evidently, no factory can afford to put two men on each job—the worker and a "slave-driver". Although workers do work under supervision, the foreman is not always behind them. Hence, they tend to loaf here and there, even if we disregard the fact that they often work slower than management expects them to work.

Apparently, there is nothing else to do than to recognize the fact that employee performance tends to vary between 40% and 80% and that it is unusual to obtain 100% performance. Yet, management must reconcile itself to the fact that when employees have a control over performance they will call the tune no matter how much pressure management exerts on them. Where supervision is superb, it is natural that employees will get away with less. But, no matter how carefully employees are supervised, in the absence of a constant moving conveyor system,

* Why not say, it is natural with all human beings as employees, assuming the hypothesis is valid; for otherwise the inference would be that workers are a distinct species of humanity, which is a totally unacceptable theory—**Editor**

performance seldom will exceed the 50% mark. The workers won't budge unless some sort of an incentive system is used which makes it worthwhile for them to turn out more than the absolute minimum.

The reader should notice that what the incentive does is to merely boost the morale and enhance the willingness to work a bit harder than one's inclination would dictate. In a sense, it will provide inducement to become more diligent so that employees won't withhold quite as much of their "productive" power as otherwise would be the case.

It seems, then, that the function of incentive systems is to raise production from say the 50% level to the 100% performance level or close to it! Those contemplating to use the incentive system to raise production in the absolute sense are operating under the dubious assumption that the incentive system can raise production beyond normal human performance. As the reader, from previous description, might surmise, this is far from being true. What any kind of incentive system can do is simply to raise production up to normal where it should be anyway, but workers, due to various reasons, are unwilling to deliver.

Where the labour union is extremely strong, slow-downs tend to be fostered by the trade union, particularly in those plants where the latter has a real say in the hiring and the firing of workers and in the determination of what is or is not adequate performance. The workers are not as complacent in situations where employees fear the day when layoffs begin. How much slow-down takes place depends often on the individual's psychology. If he is not too afraid that he will lose his job, he is more complacent and as a matter of fact he actually will stretch the job to make it last longer. Where the worker nostalgically clings to his job, performance tends evidently to be closer to 100%. In the American setting, where jobs are relatively plentiful, where there are often multiple income receivers in the family, where labour mobility is high, etc., complacency on the job tends to be more prevalent than fear. Therefore, management in the United States attaches a great deal of attention to developing suitable Wage Incentive systems so that planning of production can be facilitated, worker performance can be stabilized at a desirable level, and cost formation can be placed under strict control.

Incentive Is What Incentive Does

If the worker is not *induced* by the incentive system, by any incentive system, it is evidently a poorly designed system. Therefore, incentives can be truly considered as incentives only if, and when, the workers consider it as such. By throwing a fish to the monkey and a bannana to the seal, no one can expect results, because the recipients do not consider the presumed incentive an incentive at all. Thus, for instance, if the worker considers the incentive pay too low, management may label it an incentive system, but labour won't consider it as such. Where incentives do not *induce* those to whom the system is directed, performance won't improve despite having an incentive system. Accordingly, the question arises as to what makes incentive systems good and, hence, successful.

Time Study and Incentives

Time study is a means by which management attempts to determine just what a fair day's work is, how many units a normal qualified workman can turn out, and what should be the **standard time** on a given job. Equipped with this information, the production control department (or whoever plans production) is able to schedule and will know how long it takes to produce the number of units ordered by the customers. By the same token, it will also be known how long a given equipment will be tied up with any given job. If mamagement bases scheduling on time study data, it is essential to assure that performance is exactly what performance should be. Scientific production planning would be useless if employees did not consistently accomplish the production schedule. And this is where the incentive system comes in handy. Management offers incentive pay to assure accomplishment of production schedules.

In the planning of production, everything is interrelated. Time standards must be developed so that accurate production plans can be set.

In turn, to assure the accomplishment, incentive rates must be set, based also upon the time study data. Evidently, management must know at the outset what employees should be able to turn out. Any discussion on incentives is bound to involve that of time study and a careful production scheduling. Otherwise, we are speaking about disjointed, if not meaningless, things.

Many companies do not plan production in a systematic manner. Thus, the company hopes to achieve efficient operations as a direct result of employee cooperation. It goes without saying that in a company where *improvising* is the rule, not the exception, there is no time gap between plan and action. Where mangement does not plan what is expected to be done, profitability is largely dependent upon chance factors. If workers perform diligently, any free machine will be assigned another work in rapid succession. Scheduling is *after the fact*. In such companies the function of incentives seems to be something which otherwise a schedule is supposed to accomplish. Evidently, this is better than nothing, but it is far from what management should do in order to bring about efficient operations.

Management should then set time standards, and use the time standard to determine production schedules and incentives. Notice that time study in itself is meaningless. What good does it do to management to know that it should take a half hour to perform a certain kind of work if management does not actually plan on the basis of the above information or use it as the basis for incentive pay? **Incentives cannot possibly accomplish production scheduling,** merely to induce workers to raise their output from, say, one half of normal performance to approximately 100%.

It must be clear by now that inefficiency does not occur so much in the mass production plant (conveyors make people perform), but in job shops. Customer orders must be shipped on time and the company must be able to ship within both the time agreed upon and the cost (that is, price) which allows a reasonable profit. But, how is it possible to accomplish this? How can we eliminate the worker's control over the production flow? Short of slave-driving and/or a conveyorized production line, we cannot eliminate it! Hence, the best thing management can hope for is to get the worker's cooperation via the incentive system.

We know that employees tend to perform below what management (based upon time studies) considers a fair day's work. There seems to be a fundamental difference between the worker's and management's attitude about what a fair day's work for a fair day's pay should be. Attitudes are attitudes! Thus, we cannot accomplish the impossible of changing human attitudes, but what management can do is to influence worker attitude favourably. By paying a *bonus* for work which is **above a certain minimum,** worker attitude can be influenced.

From the aforementioned it is implied that there are two basic problems facing management when contemplating introduction of an incentive system: (1) the size and nature of the bonus pay, and (2) the minimum output requirement. These factors are extremely important. Indeed, whatever decisions are being made on these scores, the employees may not fundamentally disagree on them. It is the worker who must consider the incentive as inducement, not solely management. If management thinks that the "extra pay" should induce anybody to work hard, but, in fact, it does not induce anybody, nothing has been accomplished! Management may knock its brains out to figure out why its incentive system does not work (and bring about the results expected). Yet, it lies in a simple truth: **the employee must like it!**

Time Study

Time study, or work measurement, can determine how long it should take to perform a given job. While this does not mean that it actually will take that long, it is a vital information upon which further decisions can be made. There is a great deal of difference between ascertaining what a fair day's work or pay is and what the time standard should be. Nevertheless, time study is one of the important ingredients in incentive development.

Although time study can be made in half-a-dozen different ways, let us talk about the stopwatch method. A man will measure how long

it takes to perform some work. But, will this method tell it accurately? Of course not! If the operator works fast, he will take less time. If he works slow, he will take more time to perform the same work. What is the *normal performance*? How can we tell normal from abnormal?

This is where the grandiose idea of work measurement and the determination of a fair day's work breaks down. Who works at a normal pace? Whose tempo is too fast? Who is working neither too fast nor too slow? These are questions no one can anwer with certainty. Ask the labour union, and it will say this man works too fast; ask the management, and it will say this man loafs on the job; ask the worker, and he will say he works fast enough for the pay he gets. So we have three opinions—three quite different ones. Probably the most difficult task is to bring these three opinions to a common denominator.

I suppose we all recognize that the actual performance time is bound to vary all over the lot depending upon the tools the employee works with and the work place arrangement. Not to a small extent the working conditons and the pace with which the employee performs the job will determine how long it takes to complete specific motions involved in the job.

Nevertheless, it is the function of time study to determine the time a job should take. By-passing the technicalities involved in the setting of the standard time and assuming that the time-study man was successful in setting it correctly, any normally qualified man performing in a normal tempo can do it without undue effort. This is, then, the **time standard**.

But, knowing the time and getting this amount of performance are two different things. Thus, for incentive purposes, in addition to the standard two more questions need to be defined; (1) fair day's work, and (2) fair day's pay. By implicatiom, then, the time standard is not identical with the concept of fair day's work! Fair day's work is *less* than the output implied by the time standard. Hence, the fair day's pay is *more* than the worker would ordinarily receive.

Fair Day's Work

The idea of wage incentives is based on the assumption that people do not produce voluntarily as much as they can. If this is true, the question is; how can management equate performance and the time standard? By paying those employees extra who perform above and beyond a given minimum, output can be maximized. The fair day's work is, then, this **minimum,** and the time standard-implied-output is the **maximum.**

There are dozens of wage incentive systems. Taylor called his system the "Taylor differential piece-rate system", and Emerson called his the "Emerson system". Every mangement expert has his system. But, regardless of which system we talk about, we are always dealing with two ideas: the minimum output where the incentive pay begins and how the incentive earning should be split between worker and management. The latter is the least important part of the problem; yet, in the literature it is given an unduly great emphasis. What really is important is that we succeed in inducing the worker so that management can cut the *unit cost*. Obviously, if we pay more to employees, we raise in fact their income instead of cutting it. Nevertheless, the objective is to pay more, all right, but to get more units for the pay than we would otherwise be able to get.

Fair Day's Pay

Although the fair day's pay is in a sense an arbitrary figure, in fact, the workers have a great deal to do with it, for management must carefully consider how much money labour would accept as reasonable for delivering a fair day's work. But, let's not confuse things! Are we speaking about work or money? Evidently, both work and pay must simultaneously be dealt with, because these cannot be treated in a vacuum.

From previous discussion, it is apparent that **work measurement** ascertained the time needed to do a certain work. The **maximum** output is hence known, under the assumption that a normally skilled worker, under normal

conditions and work pace, would be able to turn out as much as implied by the time standard. Say, the time standard (including allowances) determines the time required to drill 10 holes including the handling. If the time allowed is three minutes, management should be able to get 20 pieces per hour. Even if the time standard is undoubtedly correct, employees just would not turn out 20 pieces per hour. Why? Because they just don't! It can be done, all right, but it won't be done!

What can management do to get these 20 pieces per hour? The answer lies in wage incentives. The mechanics of wage incentives is to set the fair day's work somewhat below the time standard. We may set it, in lieu of 20, at 15 pieces an hour. Accordingly, the fair day's work is 8×15 pieces or 120 pieces a day.

What is now the fair day's pay? Under this assumption, the worker's day rate is paid for the first 120 pieces. For the surplus he will get extra pay (bonus). In other words, the fair day's pay is based on a somewhat lower output level than the "normal" worker is capable of turning out.

Piece Rates or Wage Incentives?

The aim of the incentive is to realize the proverbial 100% performance. If the time standard says that management should be able to get 160 pieces per day (three minutes each), we would assume that this is what will be achieved. But, the worker resists and turns out only 80 pieces a day! What can management do? Fire him? No, instead, we pay incentives by setting a minimum output which will be interlaced with extra pay for the units above and beyond this minimum. Whereas the daily output is set at 120, we hope for the maximum of 160. Assuming that the worker earns eight dollars a day (based on his $ 1 per hour wage rate) he will be able to finish the first 120 pieces after the sixth hour. In the next two hours, he will be able to turn out another 40 pieces for which he will get bonus pay equivalent to two hours' output. Thus, the total earnings of the worker will be $ 8 + $ 2 = $ 10, and, instead of a minimum, the worker delivered the expected maximum. Although we paid $ 2 more per day, our labour costs came down, because for $ 10 we received 160 pieces which otherwise would have cost us considerably more per piece.

The piece rate would be quite similar, except that the worker is paid by the piece. If his wage rate is $ 1 per hour, and the fair day's work is 15 pieces (as opposed to the maximum output of 20 pieces per hour), the piece rate is $1/15 pieces = $ 0.066. The basic difference is that the wage incentive pays hourly rates, whereas the piece rate pays in accordance with the number of units the employee delivers. The base rate is guaranteed in most wage incentive systems, whereas the piece rate has its penalty aspect because pay depends on output.

The Various Wage Incentive Systems

All the incentive systems are based on the above principles, but the "bonus" arrangements tend to differ. A standard is usually set below what the stop watch reading would warrant. The minimum can be set at different levels, but always below the stop watch reading. The achievable maximum is the output which the normally skilled worker seldom can exceed—only the superior worker. But, of course, most superior men leave or are promoted, and hence, a department is usurally stuck preponderantly with average men.

Fair day's work is always **a minimum.** By the same token, "bonus" is paid for performance above and beyond the minimum. In this sense, a "fair day's pay", and a "bonus pay" are warranted.

The bonus pay is computed by various systems differently. The bonus is not calculated on the basis of the worker's normal wage rate, but management tends to split (in some predetermined ratio) the bonus with employees. In some instances, the bonus is based on an escalator to assure achievement of the maximum. Near the maximum point, the worker may be offered a higher bonus than close to the minimum point. However, this may not be so because in some wage incentive systems, bonus pay may be quite significant at or around the minimum rate, to assure that workers make an attempt to surpass it so that a higher base rate is obtained.

What we want in return for an "extra" pay is an extra output. Instead of 50%, we hope to get 100%. We don't mind paying higher income as long as we still succeed in cutting the unit cost. It it then not a paradox as it seems to be that costs go down despite wages going up.

Summary

On the one hand there is a great deal of confusion as to what a wage incentive system can accomplish and on the other hand as to which system is the best. The answer is that the wage incentive system must be tailor-made to suit the plant's specific circumstances.

In conveyorized production lines, for instance, there is no need at all for an incentive system, because the **work pace** is set by the movement of the production line. If the line is well synchronized, but no mechanical means set the pace, **a group incentive** may accomplish what supervision cannot often accomplish, namely, to control the performance of the group as a whole. If the **incentive pay** is sufficiently attractive, the employees will take care of those in the group who slow down production. Thus, employees will police themselves. Bonus pay is paid for the output which exceeds a preset **minimum**. To maximize bonus pay, the group must maximize output.

Incentives are almost necessary in plants where **performance** and hence output of the plant, depend on the cooperation of the worker. Some people dislike to hear that incentives offer a **bribe**, so to speak, to induce employees to produce up to their productive abilities; nonetheless this assertion comes close to being true. Thus, management—via the time study—determines the **minimum** (fair day's work) which management expects of the workers. The pay for this minimum is what we call **a fair day's pay.** Workers receive extra pay (bonus) if they exceed this minimum. The bonus pay is in some ways proportional to the surplus output (excess over the minimum requirements).

To make the system work, the minimum requirement must be set quite leniently, simply because if the standard is too tight, the incentive pay tends to be so small that employees do not find it worthwhile to work so hard.

And a final word: The incentive system will work and accomplish its purported purposes only if employees like it. Thus it is not management who must like the incentive system, but the worker. Whether the system is a failure or a success depends on how well management appraised the wishes and desires of the working group as a whole.

Ask God for a Plan of Financing

". . . He is a business-efficiency consultant who answers his clients' urgent calls for help by rushing round and dropping on his knees with them in the boardroom, to pray for the Lord's instructions on how losses may be turned into profits, provided, of course, that the Lord wishes profits to be made in that particular case. To lesser people in financial difficulties he counsels: 'Take all your bills; lay them out on the table. Then ask God what to do about them. Ask Him for a definite plan of financing. . . . ."

From *Chaplain to the White House: Profile of Norman Vincent Peale*, *NEW STATESMAN*, *24 Jan. '69*

The Miroku Accounting System of Japan

Shahid Pravin*

IT WAS A SCOTTISH BANKER WHO INTRODUCED the 'slip system' of accounting in Japan. Japan uses the Chinese characters in writing. In China an average literate person needs learn something like seven thousand characters and to remember these one must practice calligraphy by writing assiduously thirty or forty characters every day. In Japan they have now reformed their writing to a very great extent. Bankers are required to close their books every day to send their returns to the Head Office. This Scottish banker must have found this task very arduous, because of the time involved in making the vouchers, entering these in the day books and posting these to the ledgers. The innovation that he brought about was to prepare every voucher in the form of a journal voucher showing the debit and credit entries simultaneously on slips of paper serially numbered. If these are filed in sequence the file becomes a journal and every transaction is treated as a journal transaction, eliminating in that process the books of original entry. These slips can be sorted out daily according to the accounts involved and the ledger accounts can then be posted individually or in totals direct to the ledger accounts. This innovation saved considerable amount of laborious clerical work.

The Miroku Accounting System

The Japanese economy is one of the world's most competitive, with the result that every month several companies become bankrupt. Business failures being such a frequent phenomena, Dr. Urabe of the Kobe University wrote a best seller on the subject.

Masayasu Suzuki, a philosopher, now in his seventies, became concerned with this large number of business bankruptcies. On studying the subject he discovered that these failures took place because the owners were not aware of their financial position in time. The closing of accounts normally took anything between three to six months and by the time they became aware of the profit or loss of this earlier period they had already become bankrupt and could not pay their bills.

Suzuki went into the subject of accounting and discovered that the most laborious part of a book-keeper's job is to post the accounts and close the books. He came forth with a uniquely simple solution which eliminated the posting and speeded up the closing. He gave to the system the name Miroku Accounting.

Miroku is the Japanese equivalent of the Sanskrit word *Maitreya*. The concept of *Maitreya Budha* or the deity incarnating from time to time to solve the world's ills gives to civilization a sense of direction. He wanted such an excellent word to describe the system. Suzuki formed a charitable or non-profit making organisation called the Miroku Accounting Association, to propagate his ideas. This Association now employs over two hundred consultants with ten offices in Japan. Thirty thousand companies are members of this association who officially use the system. Several thousands more use it unofficially. The finances for the association come primarily from the profits of a printing company which it owns, which provides the forms, the folders and other requisite stationery to run the system. The association also has an electronic data processing

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division for the use of its members, and training centres to train book-keeping clerks, mostly girls in Japan.

The System

The concept of accounting and the presentation of accounting information can be represented in the following diagram.

ASSETS	LIABILITIES
Code Nos. 1000-1999 or 100 to 199 Green	Code Nos. 2000-2999 or 200-299 Red
EXPENSES	**INCOME**
Code Nos 3000-3999 or 300 to 399 Yellow	Code Nos 4000-4999 or 400 to 499 Blue

All assets are normally debit balances and these are shown on the left hand or debit side. All liabilities are credit balances, which appear on the right. Expenses are debit balances, and Income credit balances and these appear accordingly in the final statement.

In the British way of presentation, however, in the Balance Sheet, Liabilities appear on the left, the Assets appear on the right, for what reason we do not know now.

The top half of the statement is the Balance Sheet, the bottom half the Profit and Loss Account.

A system of numbering the accounts is used, to avoid errors in posting. Code numbers 100 to 199 or 1000 to 1999 represent asset accounts. The numbers of accounts operated will determine the number of digits to be used for this numerical classification. Liabilities have codes 2000 to 2999, Expenses 3000 to 3999 and Income 4000 to 4999. The trial balance itself is in the form of the final reporting statement, the ledger accounts are also arranged in the same sequences and therefore no marshalling of accounts becomes necessary.

To make the system foolproof, to avoid errors in accounting even by untrained girls, a colour scheme is used, a combination of any four colours. For example Green for assets, Red for liabilities, Yellow for expenses, Blue for income. The ledgers or ledger binders are of these colours, and also the corresponding vouchers. The codes spell for accuracy; if you fail on that the colour disparity highlights attention, unless of course you are colour blind.

The Vouchers

Every transaction is recorded on a voucher, on the unitary principle, that is the slip system, in the form of a journal voucher, showing simultaneously the debit and credit entries. These vouchers are strips of paper and on a form designed more or less like what is shown below. Modifications are possible.

The slips have one or two holes punched to file these vouchers in ring binders or paste them one below the other in the serial and date sequence. The first column shows the serial number of the voucher and the next columm the date. Columns follow to show the code numbers of the debit and credit accounts. The details show the transaction, Salary for AB being paid by cash for August 1969 amounting to Rs. 600. Columns to show the debit and credit amounts, and to indicate the balance when needed are provided.

0	No.	Date	Dr. Code	Cr. Code	DETAILS	Dr. Amt.	Cr. Amt.	Balance
0	115	31.1.69	325	186	Salaries Cash Salary of AB for Jan'69	600.00	600.00	

These vouchers are made out in three or more copies according to the needs of the situation. In this particular case the original voucher is in white which is filed serially and forms the journal. These forms are printed with carbon coating on the back, like the Airlines tickets. The second copy is Yellow in colour, the colour code for expenses. The original voucher will not have carbon coating on its back for the column where the credit amount is indicated, and for that reason the debit amount alone is shown on this voucher against the salaries account. The third copy is Green in colour, the colour code for Assets. The second copy of the voucher will have no carbon coating corresponding to the column where debit amount is shown so that on the third copy the credit amount alone will appear against the cash account.

Ledgers are in the form of loose-leaf ring binders, with or without transparent paper interleaving to keep the vouchers in position. These binders will be in the same colour as the account it represents. The second copy will be filed in the yellow binder or salaries account, code number 325. The third copy, the green voucher, will be filed in the cash account binder, code number 186 which is a green binder, the colour code for assets. In this process the posting work is eliminated. In one writing three vouchers are created, one for the journal eliminating the book of original entry, the other two vouchers to serve the purpose of posting to the corresponding debit and credit accounts. Where control accounts and subsidiary ledger accounts are to be operated, additional number of copies can be made out to suit the situation.

At the end of the day the ledger accounts are balanced, that is the debit columns and the credit columns are added and on the last voucher the balance is shown in the balance column, which forms the balance to be carried forward for the next day's balancing. These balances at the end of the day are transcribed on a preprinted form which forms the Balance Sheet and the Profit and Loss Account.

This takes hardly ten minutes at the end of the day and the closing work is therefore speeded up.

BALANCE SHEET

Date.....

Assets			Liabilities		
Code No.	Account	Amount	Code No.	Account	Amount

PROFIT AND LOSS ACCOUNT

Expenses			Income		
Code No.	Account	Amount	Code No.	Account	Amount

Companies of medium size are able to operate the entire system with hardly one or two girls, who produce daily a Balance Sheet and Profit and Loss Account without much effort. Adjustment entries for depreciation, accrued and prepaid expenses are made monthly on the same type of voucher forms to present monthly financial statements which are on similar forms.

The training of the clerks in the Associations school takes a few days or hours as against months or years required under the convention methods for Book-keepers or Accountants. Accountants in this process cease to be book-keepers. They become financial managers of the company, evaluating the financial consequences of management decision-making on a day to day basis.

From the Miroku or the One Writing System to computerisation or electronic data processing is an effortless step. Even very small companies in Japan use such equipment for processing their accounting data. These vouchers or slips are sent to the service bureaus where they are processed and returned to the companies along with the tabulated statements. Trade Associations, Chambers of Commerce, Management Associations, Productivity Centres and Computer Companies operate service bureaus at convenient locations to process company data and they are billed according to the time taken.

It was my privilege to meet Mr. Suzuki and his associates, particularly Mr. Shirakami, on several occasions during my stay in Japan in July-August 1968: they gave me the opportunity to study the system in operation at several of their client companies, so that an account of the system could be published for the first time outside of Japan, and I thank them for this.

Workers' Plane of Living in West Bengal*

RR Singh[1]

To ensure clarity of thought, the two expressions 'Standard of Living' and 'Levels or Planes of Living' may be distinguished, both in their connotation, as also in their denotation. Standard of living may be regarded as the quantities (significantly conditioned by their qualities) of food, clothing, shelter and various other commodities and services which an individual, a family or a group considers essential to his or its welfare or happiness. On the other hand, a plane of living may be defined as a measure of economic consumption: the amount of income which an individual or a family actually does consume. A plane of living is essentially those things to which we are accustomed. Expressed more significantly, a standard of living is the idealization of an actual plane of living. The former represents a social aspiration whereas the latter constitutes a grim economic reality. Very obviously, the author here strikes a much needed and a rather rich vein of analysis.

WHAT IS CALLED AN ATTITUDE OF MIND VARIES from individual to individual, and even with the same individual, from time to time. The poor may be happier than the rich because happiness is more a state of mind than a condition of material well-being. Hence, the philosopher may object to consumption measurement and insist on psychological tests. The economist, however, finds it **difficult to define and impossible to measure** in monetary terms such subjective concepts as individual happiness and social welfare:[2] as such the economist is forced to content himself with defining and measuring planes of living in terms of commodities and services consumed. **Prosperity is measureable but happiness is not,** wealth is definable but welfare[2] is not; hence our materialistic concept of standards and planes of living.

The concept of level of living embraces all types of material and non-material wants. So far as consumption of material goods is concerned, the level of living refers to the quantitative and qualitative consumption of goods and services. The non-material aspects in their turn are conditioned, to a great extent, by the political climate, social policy and several other factors which naturally differ from society to society and individual to individual. The social, political and economic institutions acting and reacting upon one another produce, in the final analysis, a profound influence on the levels of living. Social and political history, in many countries, bears testimony to the fact that the economic system is, in the main, determined by social and political forces. Sometimes, of course, these forces assume a secondary role and are them-

*Note: All Footnotes Editor's, except on page 288.

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[2]How about Professor Pigou's Wealth and Welfare? Even Professor Alfred Marshall's *Principles of Economics* are very largely, what may legitimately be called Principles of Economic Welfare.

selves reoriented and moulded by the existing economic system. Thus Economics acquires its own dynamism. Modern economic history of the USA has in no less degree determined and shaped its social and political systems.[3] Economic organisation in South Africa controlled by the existing social and political institutions explains the low levels of living to which non-European immigrants[4] are condemned.[5]

The plane of living is the outcome as much of the distributive as that of the productive system. Both are interlinked and their combined impact cannot be treated in isolation. How wealth is distributed depends upon the nature of the productive apparatus. In turn it is the distribution of the produced wealth which will direct the flow of productive efforts. What matters to production-workers is not the particular wage rate alone, be that slightly higher or lower but also the volume of employment offered at the varying rates of wages. **Under Indian conditions, employment is no less important than the level of income.** Obviously it is not only the size of earnings but also the total volume of employment made available by the productive organization at different income levels which produces a considerable impact on the levels of living. **If Labour's share in the gains of industry contracts, the productive effort expended on the production of goods consumed, will also contract.**

Workers' Efficiency

It is the productive and distributive systems obtaining in a society that create employment and income over which the workers' control is limited. His efficiency, however, can ensure him, to a very large extent, a regular employment[6] and a higher level of income resulting from his larger outputs. The quantitative and qualitative improvement in his output is bound to raise his income and level of living. It may, however, be observed that apart from earnings, efficiency is also susceptible to the mode of spending the earned income. If the worker does not judiciously spend his income in obedience to the laws of ethics and economics, his plane of living may be lowered.[7] Moreover the nature of political institutions will determine the extent of interest that the State may take by regulating wages and launching ameliorative schemes such as social security, labour welfare, housing, general and technical education and a host of other beneficial measures. All such efforts, individual or collective, exert their influence on the workers' plane of living.

In addition to various factors, social, political and economic, acting and reacting directly or indirectly on the workers' share in the gains of industry, it is germane to examine and analyse the factual data bearing on earnings, spending and employment; since **the workers' plane of living is a direct consequence[8] of how much wealth is produced and in what manner it is distributed among the various factors of production.**

To study trends in the levels of living over the last two decades, a major sector of the Jute Textile Industry of West Bengal accounting for about one-fourth of the total textile labour force in the country has been picked up for economic analysis.

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[3]This, of course, is purely Marxian Theory.

[4]Non-Europeans, particularly Africans, are not immigrants. It is the Europeans, who are immigrants.

[5]Would it not be the other way round that the political and social system condemns the non-Europeans to a low level of living? On the other hand, the economic organisation really yields, even as it is, very substantial surpluses, which could legitimately be spent on raising the living standards of non-Europeans, without in any way affecting the standard of living of the European classes.

[6]As an individual; but at the macro level, individual or collective efficiency or willingness or stubbornness does not determine the volume of employment. Please see Keynes's *General Theory* etc.

[7]This applies to every class, not only the workers.

[8]Also of many other factors.

Weekly* Minimum Money and Real Earnings in Jute Industry

	1951	1955	1961	1963	1967†
Working Class Cost of Living Index Numbers	100	99	110	120	170
Spinning:					
Hessian Sirdars:					
Money Wage (Rs)	23.2.6	24.1.9	24.15.6	26.3.2	34.9.8
Money Wage Index	100	104	108	113	150
Real Wage Index	100	116	98	94	88
Sacking Spinners:					
Money Wage (Rs)	17.11.6	18.10.9	19.8.6	20.12.2	29.2.8
Mony Wage Index	100	105	110	117	165
Real Wage Index	100	117	100	98	97
Weaving:					
Sacking Sirdars:					
Money Wage (Rs)	28.0.9	29.0.0	29.13.9	31.1.5	39.7.11
Money Wage Index	100	104	107	111	141
Real Wage Index	100	116	97	93	83
Hessian Weavers:					
Money Wage (Rs)	20.7.3	21.6.6	22.4.3	23.7.11	31.14.5
Money Wage Index	100	105	109	115	156
Real Wage Index	100	117	99	96	92
Operatives:					
Money Wage (Rs)	16.1.9	17.1.0	17.14.9	20.4.0	28.10.6
Money Wage Index	100	106	111	126	177
Real Wage Index	100	118	101	105	104

Labour publications, both government and private, are invariably marked by a significant paucity of satistical data bearing on basic wages and earnings of workers in the jute mill industry of West Bengal. It was in 1948 that the first award of the Industrial Tribunal rationalized, to some extent, the unregulated wage structure in jute industry. The second award in 1951 and the third award in 1955 secured to all categories of workers uniform increases in money earnings, while the cost of living, during the same period, dropped by ten points. This resulted in a uniform recovery of real earnings for all workers, but the recovery proved to be a transient phase. Even the **interim** relief granted piece-meal by the Central Wage Board for the Jute Textile Industry effective from 1960 and 1961 could not reach out to the continuously rising cost of living. All categories of workers could hardly hold on to their 1951 position.

The Central Wage Board in its final award (1963) revised the basic wage structure which brought sustaining relief especially to the unskilled workers in spite of the rising price-spiral. Additions to basic wages of skilled workers proved relatively to be rather marginal. By 1967 the skilled occupations, relatively to the unskilled, were at a considerable disadvantage in terms of real wages; since the system of variable dearness allowance linked to cost of living,

*Awards of the Industrial Tribunals 1948, 1951, 1955 and the award of the Central Wage Board for the Jute Textile Industry (1963) constitute the bases for estimating the minimum earnings.

†The figures of Average D.A. for 1967 are supplied by Indian Jute Mills Association.

introduced for the first time in the industry, ensured equal increases in earnings of skilled and unskilled workers alike. The latter as a consequence could maintain more than their *status quo* but the former experienced a relative set-back in their planes of living over the period under observation. The real wage of the sacking sirdars, a skilled occupation, touched as low as 83 by 1967.

The broad conclusion that emerges from the data tabulated is that unskilled categories like the operatives had slightly improved their position by 1967, but skilled workers had, in fact, sustained marginal to substantial losses. Generally speaking there would have been a further worsening in the real wage position, had it not been for the system of variable dearness allowance linked to cost of living introduced by the Central Wage Board for the Jute Textile Industry effective from 1963. The logical inference is obvious. The jute textile worker should not depend too much on such statutorily-backed awards. For a substantial improvement in his plane of living he should gradually build up his operational efficiency and thereby increase the size of the cake in order to justify his claim for a bigger slice.[9] Enlightened self-interest should make him realise that increases in money wages larger than those required to compensate him against the rise in the cost of living are not possible so long as his productivity does not increase *pari passu*.

Shifts in the volume of employment between different income brackets are significant. The total labour force in the jute industry of West Bengal in 1944 was in the lower income bracket, not exceeding Rs. 2/- per day. By 1959 the position was entirely reversed: practically none remained in the lower stratum. About 86% of the entire labour employed in the industry got into the middle income group and the rest, nearly 14%, jumped into the highest income bracket, in receipt of daily wages ranging between Rs. 4.01 and Rs. 6.00 and above. **This wholesale upgrading of labour from lower to middle and upper income strata is a highly redeeming feature.** The jute workers, condemned to a very low standard of life for decades, came to heave a sigh of relief and satisfaction.

The reader should, however, be cautious and need not lay more store by the foregoing observations than for what they are worth. The rising levels of money income, each accounting for an increasing percentage employment now than before, do not necessarily mean rising levels of real income too, and have to be interpreted against the background of the ever-swelling cost of living. Higher levels, both of money income and relative employment, inflated as they are to some extent, may not constitute an appreciable real improvement in the workers' plane of living.

Levels of Income and Relative Employment

Year	Upto Rs. 2.00	Rs. 2.01 to Rs. 4.00	Rs. 4.01 to Rs. 6.00 & above
1944	100%	×	×
1959	0.1%	86.1%	13.8%

Family Budgets

Differences in incomes produce differences in planes of living. Even within similar income groups, considerable differences in consumption exist. Some groups spend more on food while others spend more on clothing. Certain groups are improvident and spendthrift while others are frugal and austere. Obviously, all such groups within the same income bracket will have varying planes of living. Different income groups spend varying proportions of their income on various items. The higher income groups spend more on the necessities of life than do the poorer

9. This applies to managerial efficiency as well; but the logic of it is not clear. Will higher operational efficiency result necessarily, by a sort of automatic process, into a higher real wage?

groups but the relative part of their entire budget is less. On the other hand, their greater income permits them to spend relatively as well as absolutely more on incidentals and comforts.

earning strength of the family both registered a perceptible decline in 1959--a logical inference of the workers' rising planes of living. It is out of compelling economic pressure that the worker

Monthly Average Percentage Expenditure Per Family—Itemwise

Items	Calcutta		Howrah	
	1944	1959	1944	1959
Food	65.66	62.31	71.49	62.59
Fuel & Lighting	7.28	4.64	7.68	5.03
House Rent	6.71	8.24	5.72	8.58
Clothing & Footwear	7.74	8.25	6.39	7.16
Bedding & Household requisites	0.06	0.36	0.67	0.46
Miscellaneous	12.55	16.20	8.05	16.18
TOTAL	100.00	100.00	100.00	100.00
Average Number of Wage Earners Per Family:	1.43	1.08	1.63	1.15
Adult Male	1.34	1.03	1.57	1.13
Adult Female	0.09	0.05	0.06	0.02

A detailed analysis of family budgets of jute workers for Calcutta and Howrah provides a peep into the fluctuating planes of living. The low percentage expenditure on food, fuel and lighting in 1959 as compared to that in 1954 is explained by the rising money incomes and the availability of some of the items at controlled rates. The amount so saved under these heads came to be spent on other items such as clothing, footwear, house rent and the miscellaneous group. The miscellaneous items absorbed a major portion of this amount. The increased percentage expenditure has made it possible for the worker to live in a more spacious house, reasonably furnished, to put on adequate and better type of clothing, and to make liberal provision for conventional needs, travel and entertainment. This is an objective assessment and a symbol of the rising prosperity of working classes. The average number of wage earners per family and the female employment as a component in the

may have to work overtime and send his wife and children to the factory for supplementing his family earnings. When his individual income appears adequate to make both ends meet, he is able to do away with extra physical strain on himself and his family. A critical appraisal of family budgets at these centres bring home the fact that the worker's plane of living is gradually rising.

In the light of the foregoing observations, it may safely be inferred that if judged from the income levels and relative percentage employment offered at those levels, or from the searching probe into his budget, the levels of living of the jute-mill worker have definitely risen during the period under study. The real wage levels, so far as the unskilled occupations are concerned, reinforce the same conclusion. The skilled occupations, of course, have suffered somewhat in terms of real wages. ●●●

Productivity and Social Factors

HR Trivedi*

In the author's opinion, India is heading towards sound economic development and material growth, along the lines of democratic decentralisation of power, and the proposed socialistic pattern of society. Under the prevailing conditions, however, the productivity of the available resources is hampered in many ways. Of the various factors having a definite impact on productivity, we shall here consider only the social factors and that in broad perspective.

THE TERM PRODUCTIVITY IS VARIOUSLY defined by various people. An acceptable definition for developing countries may be to say that productivity constitutes the human endeavour to produce more and more with less and less inputs of resources as a result of which the benefits of production may be distributed more equitably among the largest number of persons. Needless to say that this refers to industry, as also to agriculture in their pure forms. Both these fields of production have, by and large, remained labour intensive. Since the gradual introduction of scientific tools and techniques, about a hundred years ago, the proportion of input of machine and manpower in production has been undergoing radical changes.

Since Independence, the country has been passing through rapid changes leading to industrial expansion. The strategy of labour or capital intensiveness of production varies from region to region, depending on the types of entrepreneurs, the quality and quantity of labour supply, above all the technical needs of the particular industry. Wherever mechanisation is being introduced in agriculture, it leads to a lowering of labour intensiveness, and the process will gather momentum, with higher and higher capital investment. This will bring us close to the new age of mechanized agriculture, which is already the established case in the developed countries of the West. More and more advanced inventions in Science and higher degree of computerisation in various fields of life, may also lead to the age of leisure for the so-called working class. At present we are nowhere near this, both from the point of view of material and human development. On the contrary, our productivity of human life is much greater; and every year we have to clothe, feed, and educate more and more people; and have to be constantly at pains to train them into viable industrial manpower.

The problems of productivity and human relations in industry, have not been thoroughly studied so far by Indian sociologists because of the lack of opportunities in the past. The National Commission on Labour, however, have brought out a Report on sociological aspects of Labour-Management Relations: this is a good beginning in the direction of identifying sociological factors in productivity. It has now been universally recognised that irrespective of political differences between nations, the industrial base rests on healthy relations among the employers and employees. Increase in productivity in underdeveloped countries like India, depends largely on the removal of economic and social inequalities between the labourers and capitalist class, and the acceptance of the fact that both these have orientations for different types of motivations. In fact they derive different kinds of psychological satisfactions from their roles as independent and free participants in the new venture for the common good.

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The late Prime Minister, Sri Jawaharlal Nehru, emphasised on India's commitment to an industrial society. He exhorted his countrymen to go to science for the solution of economic problems and repeatedly asked them to increase technical competence, punctuality and regularity of factory life. He attacked social backwardness and saw the germs of progress in changing industrial relations, clogged by inhibiting social conditions. The emphasis he laid was on changing behavioural patterns which included mutual trust, cooperation and sharing of ideas and experiences among the employers and employees. With the development of healthy relations based on understanding and foresight, things can improve: so the late Prime Minister thought. In short, he wished that the Indian people must shift quickly towards modernity, leaving aside the values and patterns of traditionalism of the bygone ages.

The people's contribution to productivity will be commensurate with the commitment to the standards of the industrial way of life. The prerequisites are that all the categories of people such as employers and employees, political and administrative leaders and the policy makers should be so committed to the ethos of the new industrial age that each respects, in thought and action, the role of the other categories of people and help to create a rational outlook on new sets of relationships.

Industrial sociologists in India have recently indicated that over a period of time, the rural migrants to the urban industrial sector had developed a positive commitment to the industrial way of life. In this, economic incentives and the desire for social status have played a significant role. A rational wage structure, security schemes, promotions, recreational and educational facilities, health and housing schemes, settlement of grievances and disputes are among the most important factors helping the growth of healthy industrial climate.

Here comes the significance of the activities of labour unions, both craft or plant-oriented, and those with 'inside' or 'outside' leaders. Mutual appreciation of and sympathetic understanding of the problems affecting human behaviour may help us in going a long way in creating a conducive atmosphere for pushing industrialisation forward and in the process, upgrading economic and social status of the parties and agents of production.

Some other broad aspects of industrial policies linked with productivity are: rational division of labour at plant level, institutional facilities for upward social mobility and modernity in the outlook of all concerned. The change of one's occupation to other than caste occupation among the employees, and the reluctance of the employers to have a permanent labour force, had once been the forces which went against the growth of the industrial way of life in India. This is no more the case now.* Similarly, the forces propelling village migrants from factory to factory, and from factory to village and back will be on the decline due to changes in the attitudes of the employers providing improved living conditions for employees near the place of work. Much, however, needs to be done in this direction, particularly because of lopsided urban growth and development, greatly responsible for the creation of physical and social *semi-urban* pockets in the entire country. Among other things, underdeveloped labour markets both in urban and rural areas have contributed towards absenteeism, turn over of employees and a casual attitude to productivity. But as and when the employers gave incentives in the form of bonus or higher wages, productivity increased with increasing regularity of attendance and stability in the place of work.

Increase in population strength in India and the free labour market may induce the belief that at present, labour commitment does not pose any special problem. However, in this age of specialisation and sophistication in industrial skills, it is facile to conclude that it would be easy to get the right type and quality of labour as and when one sends for. Even if this is possible, it is doubtful if frequent turn over of labour will not be on the whole costly due to social and psychological disharmony

*Obviously the author is wrongly informed, for most employers are still reluctant to have a permanent labour force. Quite a large number of workmen are still employed on a casual basis and the workers so employed, largely through contractors, do not enjoy the benefits of leave or provident fund.—*Editor*

it may create among employees. It is, however, proved conclusively that well-calculated initiatives on the part of the employers in improving labour relations by various ameliorative measures, and the recognition of the legitimate role of labour unions, would generate the spirit of commitment in industry. Obviously this refers to the benefits that would accrue to all concerned.

The attitude of the employers of different categories, e.g. public sector, private sector, foreign collaboration and family enterprises may show differences in their treatment of employees; but each within their means can certainly induce the climate of commitment on the basis of how much they provide for job security, better wages, promotions, bonus and fringe benefits including facilities for housing, health, transport, education, recreation, etc. In brief, the best industrial relations form the haul mark of high productivity and profitability.

The social distance, economic disparity and educational gulf between the employees and the employers or managers are on the decline during recent years. This is a qualified generalization, as we in India have hardly made a beginning in the understanding of socio-economic relations. Our knowledge of the real working relationships, whether based on traditional caste-wise loyalty or business-like and bargaining relationship, is hardly adequate in any field. Changes are, however, noticeable where employees are well organised in spite of old-fashioned employers. In the same way, where the management is equipped with modern knowledge of industrial management, the employees receive a fair amount of recognition, and this has a positive impact on productivity. However, when the employees are divided into groups with divergent political motives, even the enlightened managerial leadership finds it difficult to maintain the minimum organisational discipline. But wherever there exists an informal sort of leadership among the small specialised groups of workers, the problems are quickly solved and productivity allowed to remain constant if not accelerated.

The most important link here is that of the few employees operating at supervisory level, When the employers exploit this medium for their narrow interest, the problems remain unsolved. But a discrete use of supervisors establishes a better atmosphere leading to better results. It may be a prudent policy on behalf of both the management and the workers' unions to contribute to the development of supervisory class in every organisation dealing with production of goods and development of resources. This medium can be effectively used in maintaining better communications between different parties and in retaining a healthy mutual image. Of course, the actual working conditions for employees and sympathetic treatment with regard to their transfers and promotions constitute strongly complementary elements leading to healthy industrial relations and better productivity. The industrial arrangements for redress of employees' grievances through labour welfare officers, Works Committees, Joint Consultation Councils, etc. may not only create a healthy industrial climate but may also crystallise interest groups essential in the development of an industrial society.

The overall maturity of the society based on achievement principles is one more important factor related to its productive ability. This can be shown convincingly by recognising active interest groups of managers and workers. These interest groups of contrasting hues become most significant in the light of India's commitment to democratic socialism. The existence of country-wide organisations such as Indian Labour Conference, Standing Labour Committee, Federations of Chambers of Commerce and Industry etc., form forums for solving industrial problems as and when they arise.

Similar organisations also exist at regional levels and function as a potential medium of tripartite consultation while negotiating disputes through governmental channels. However, the behaviour of the three parties at the negotiating table at the regional level is characterised by mutual distrust and prejudice; and this is true even with regard to the government machinery which always looks to its own interest as major employer. The attitudes and behaviour of the three parties in industrial relations at the national level is less prejudicial and more broad-based; and happily it does not smack of closed ranks and narrow loyalties of small groups which

more often than not result into conflicting claims and counter-claims of sharing the benefits of production.

The hard rock of productivity is, however, industrial peace derived from job satisfaction not only of employees but also of managers and employers. The nation-building awareness in the society as a whole and well-conceived governmental policies towards industrial demands are bound to reduce social cost of industrial development. Moreover, well planned urban environment, checking unhealthy conditions of *semi-urban pockets** in industrial areas and controlling the urban explosion will be equally important aspects of industrial peace. Unless we check widespread dissatisfaction and disintegration of social cohesion and human values, we may not be able to emerge as a satisfied productive society. The local bodies in charge of urban development must implement functional planning including landscape, architecture, transport, cooperatives and other amenities in health and sanitation programmes. Where necessary, working class residential areas planned on modern lines and institutional arrangements may be made available for various kinds of social services. The use of more and more advanced technology makes it most pertinent to provide the institutional means for literacy and higher education of the employees to eliminate obstacles to industrial efficiency.

*According to the author, **semi-urban pockets** of various forums and dismensions have been rapidly growing in India, both in the so-called urban and rural areas. He has expounded the **concept of semi-urban pocket** in his paper recently published in *Human Organisation* (Vol. 28, No. 1, 1969) a Journal of Applied Anthropology in the USA. The author believes that the recent phenomena of *venas* and *gheraos* are causally linked to the sociology of this **semi-urban pockets**. The recognition and acceptance of this reality as a significant aspect of rapid change at macro level, will possibly go a long way in tackling the problems of nation building, let alone productivity.

THE AFFLUENT SOCIETY

In an article on Canine Affluence, the Sunday Evening Post referred to the Manhattan classified telephone directory, listing 115 hotels, country clubs, bath clubs and beauty shops for dogs, where hi-fi music soothes wowser (American popular name for dog) as his toes are manicured in emporia with names like The Poodle Boutique and Bow Wow Glamour... In New York, for example, you can outfit your Afghan hound in lace pyjamas ($ 25) false eyelashes ($ 3.95) or a custom-made grey chesterfield overcoat with a velvet collar and matching top hat (a bargain at $ 33.50). Or your mastiff can be scented with Kennel no. 9 and immortalized in our puppy's Baby Book, with spaces provided for new prints and such entries as 'My First Birthday' and 'My First Christmas'... All told, Americans, out of worthy sentiment, spend around 3 billion dollars a year on pet furnishings and supplies: pet food alone outsells baby food by nearly two to one. Yet this same society is presently in the midst of a potential uproar over a health-care plan for aged humans that involves an average payment per worker of about $ 1 a month through social security.

Limits and Fits in Valve Gear Links

G Surya Kumar*

This article describes a recent improvement in a particular valve gear, which plays a vital role in the efficient performance of a steam engine. It is true that the steam engine may, in the not distant future, become, like the tram car, a historical curiosity,† but this line of thinking could easily find application in other industries. Further, so far as India is concerned, steam engines are likely to dominate the scene for quite some time, in spite of increasing dieselisation and electrification; and as long as it is there, improvement in its quality and control, and attempts at economic methods of manufacture of its components, will be worthwhile.

ALL THE ENGINES OF MODERN STEAM LOCOMOTIVES have a "Walscheart Valve Gear" with an inside admission piston valve. Needless to say, the valve gear plays a vital role in the efficient performance of the engine. The linkage of the valve gear is shown in Fig. 1. At each of the joints marked 1, 2, 3, etc., there is a fork end and butt end combination with a "motion pin" linking them. This is shown enlarged in the inset in Fig. 1. Generally, the fork end has the "fixed holes", that is to say, the motion pin is a transition fit in these holes. A split taper pin secures the motion pin at either end, preventing its rotation as well. The butt end has the "floating hole"—the motion pin being a running fit in it. The fixed hole has a bushing made of medium carbon steel which is renewed only when it reaches the condemning size (4 mm above the nominal dimension). The floating hole has a gun metal bushing which has to be renewed at every overhaul. The motion pins are made of case carburised and hardened mild steel. These pins are renewed at every overhaul. The fixed and floating holes are ground to the required size by a planetary grinder whereas the motion pin is ground on a centreless grinder.

*Production Engineer, N.E. Railway, Gorakhpur.

†British Railways manufactured the last steam locomotive way back in 1961 and christened it "The Evening Star".

Since the locomotive visits the shops at periodic intervals of 1½ to 2 years, for overhaul, the problem is to ensure proper limits and fits at these locations. This was ensured in the following manner:

The fixed holes were taken as the datum. 21 "GO", "NOT GO" plug gauges were made between the extreme dimensions—viz. in steps of 0.20 mm. The tolerance given on these was
+0.011 mm.
−0.005 mm.

Corresponding to each of these gauges, another set of 21 snap gauges were made to dictate the size of motion pins—the motion pin being a transition fit in the fixed holes, the fit ranging from a maximum interference of 0.011 mm. to a maximum clearance of 0.045 mm.

A third set of 21 gauges were made for the floating holes, to ensure that the motion pin would have a clearance of between 0.069 mm. to 0.125 mm.

The plug gauges for fixed holes were numbered G/GA-164/1 to G/GA-164/21. Similarly the plug gauges for floating holes and snap gauges for motion pins were numbered G/GA-165/1 to G/GA-165/21 and G/GA-166/1 to G/GA-166/21 respectively, keeping in conformity with nomenclature for jigs, fixtures, dies and gauges in the

Fig. 1

Motion Link Diagram of Walscheart Valve Gear

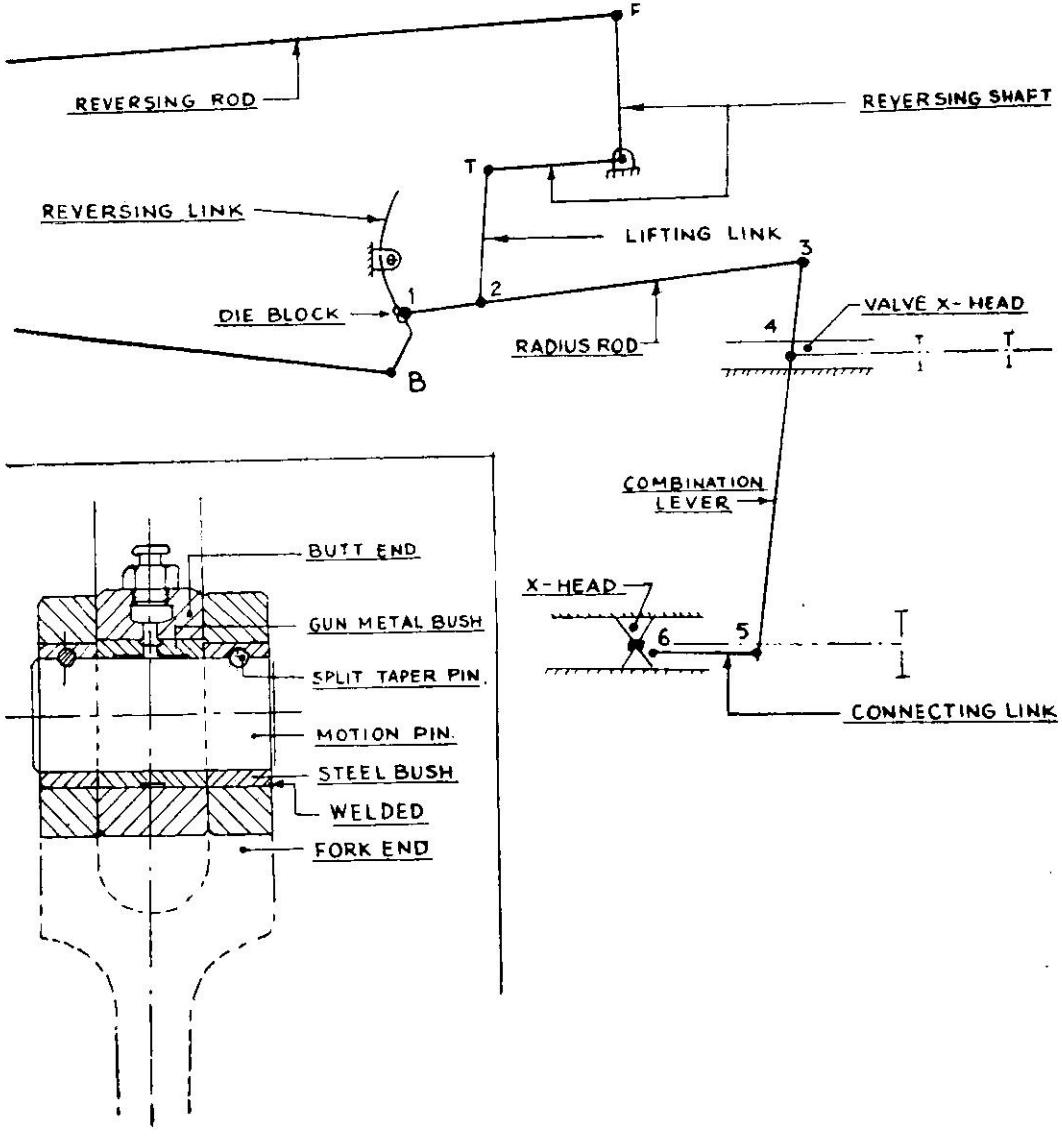
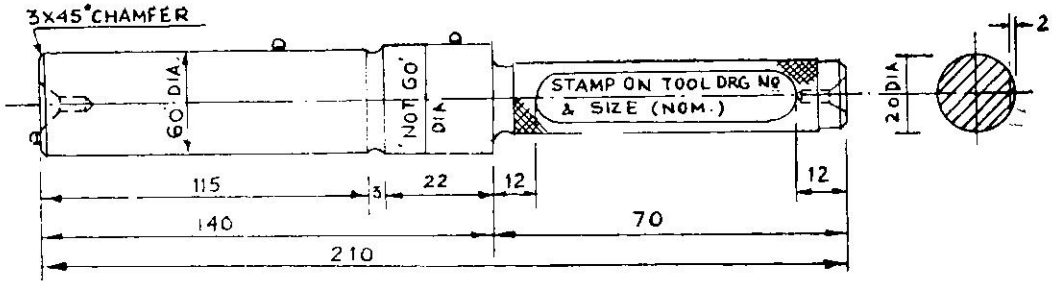
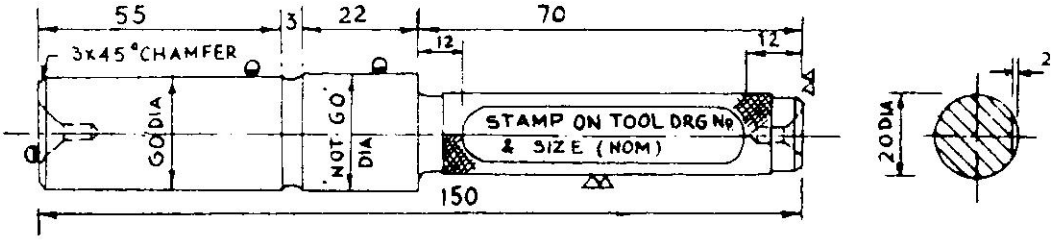


Fig. 2. *a*
Gauge to Measure Motion Link Fixed Hole
From 38 $^{+.04}_{-.00}$ Dia to 42 $^{+.04}_{-.00}$ Dia in Step of 0.20 mm. G/GA



TOOL No.	NOM. SIZE	'GO' DIA.	'NOT GO' DIA.
G/GA-164/1	38 $^{+.04}_{-.00}$	38.00	38.04
G/GA-164/2	38.20 ,,	38.20	38.24
G/GA-164/3	38.40 ,,	38.40	38.44
G/GA-164/4	38.60 ,,	38.60	38.64
G/GA-164/5	38.80 ,,	38.80	38.84
G/GA-164/6	39.00 ,,	39.00	39.04
G/GA-164/7	39.20 ,,	39.20	39.24
G/GA-164/8	39.40 ,,	39.40	39.44
G/GA-164/9	39.60 ,,	39.60	39.64
G/GA-164/10	39.80 ,,	39.80	39.84
G/GA-164/11	40.00 ,,	40.00	40.04
G/GA-164/12	40.20 ,,	40.20	40.24
G/GA-164/13	40.40 ,,	40.40	40.44
G/GA-164/14	40.60 ,,	40.60	40.64
G/GA-164/15	40.80 ,,	40.80	40.84
G/GA-164/16	41.00 ,,	41.00	41.04
G/GA-164/17	41.20 ,,	41.20	41.24
G/GA-164/18	41.40 ,,	41.40	41.44
G/GA-164/19	41.60 ,,	41.60	41.64
G/GA-164/20	41.80 ,,	41.80	41.84
G/GA-164/21	42.00 ,,	42.00	42.04

Fig 2. *b*
Gauge to Mea ure Motion Link Floating Hole
From 38 $^{-.12}_{-.08}$ Dia to 42 $^{-.12}_{-.08}$ Dia In Step of 0.20 mm. G/GA.



TOOL No.	NOM. SIZE	'GO' DIA.	'NOT GO' DIA.
G/GA-165/1	38 $^{-.12}_{-.08}$	38.08	38.12
G/GA-165/2	38.20 ,,	38.28	38.32
G/GA-165/3	38.40 ,,	38.48	38.52
G/GA-165/4	38.60 ,,	38.68	38.72
G/GA-165/5	38.80 ,,	38.88	38.92
G/GA-165/6	39.00 ,,	39.08	39.12
G/GA-165/7	39.20	39.28	39.32
G/GA-165/8	39.40	39.48	39.52
G/GA-165/9	39.60	39.68	39.72
G/GA-165/10	39.80	39.88	39.92
G/GA-165/11	40.00	40.08	40.12
G/GA-165/12	40.20	40.28	40.32
G/GA-165/13	40.40	40.48	40.52
G/GA-165/14	40.60	40.68	40.72
G/GA-165/15	40.80	40.88	40.92
G/GA-165/16	41.00	41.08	41.12
C/GA-165/17	41.20	41.28	41.32
G/GA-165/18	41.40	41.48	41.52
G/GA-165/19	41.60	41.68	41.72
G/GA-165/20	41.80	41.88	41.92
G/GA-165/21	42.00	42.08	42.12

Fig. 3

INSPECTION & REQUIREMENT SHEET FOR MOTION PINS & THEIR EYE HOLES

Class of Repair **P. O. H.** *W/O* **3E** *Engine No. & Class* **2664/YP**

Date Received **25-2-69** *Date Despatched* **10-3-69**

Required Diametres in Terms of Gauge Nos. for Motion Pins and their Eye Holes

	DESCRIPTION	GAUGE NOS. AT MOTION PIN LOCATION NOS.									Remarks
		1 Die Block & Radius R	2 Radius R & Lifting L	3 Radius R & Combn. L	5 Combn. L & Valve X-HD	5 Combn. L & Conn. L	6 Conn. L & X-Head	B Rev. L & Ecc. R.	T Lifting L & Rev. Shaft	F Rev. Shaft & Rev. R	
R. H.	Fixed Hole	G/GA-170/4	G/GA-164/3	G/GA-164/7	G/GA-164/4	G/GA-167/9	G/GA-167/12	G/GA-164/3	G/GA-165/15	G/GA-164/18	
R. H.	Floating Hole (Butt) Motion Pin	G/GA-171/4	G/GA-165/3	G/GA-165/7	G/GA-165/4	G/GA-168/9	G/GA-168/12	G/GA-165/3	G/GA-165/15	G/GA-156/18	
R. H.		G/GA-172/4	G/GA-166/3	G/GA-166/7	G/GA-166/4	G/GA-169/9	G/GA-169/12	G/GA-166/3	G/GA-166/15	G/GA-166/18	
L. H.	Fixed Hole	G/GA-170/6	G/GA-164/5	G/GA-164/8	G/GA-164/3	G/GA-167/10	G/GA-167/7	G/GA-164/5	G/GA-164/15	G/GA-164/12	
L. H.	Floating Hole (Butt) Motion Pin	G/GA-171/6	G/GA-165/5	G/GA-165/8	G/GA-165/3	G/GA-168/10	G/GA-168/7	G/GA-165/5	G/GA-165/15	G/GA-176/12	
L. H.		G/GA-172/6	G/GA-166/5	G/GA-166/8	G/GA-166/3	G/GA-169/10	G/GA-169/7	G/GA-166/5	G/GA-166/15	G/GA-166/12	

NOTE : THE FOLLOWING GAUGES ARE TO BE USED :

(a) G/GA-167, G/GA-168 & G/GA-169 for Fixed Eye, Floating Eye & Motion Pin respectively for 32 mm. Dia. (Nom.)

(b) G/GA-164, G/GA-165 & G/GA-166 for Fixed Eye, Floating Eye & Motion Pin respectively for 38 mm. Dia. (Nom.)

(c) G/GA-170, G/GA-171 & G/GA-172 for Fixed Eye, Floating Eye & Motion Pin respectively for 44 mm. Dia. (Nom.)

TO

THE FOREMAN/CPS.

for necessary action

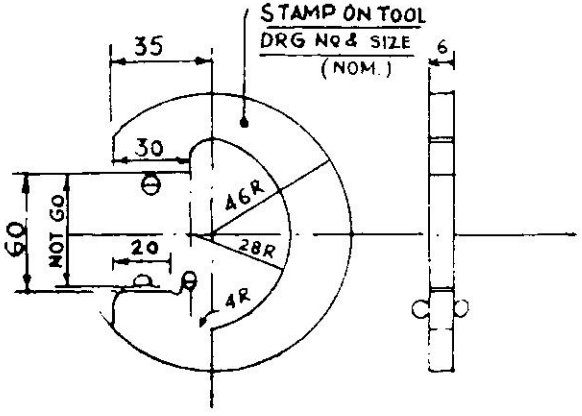
INSPECTED BY (NAME) x. y. z.

SIGNATURE & DATE Sd/.

Fig. 2. c

Gauge to Measure Motion Pin Dia

From 38 $^{+.011}_{-.005}$ to 42 $^{+.011}_{-.005}$ in Step of 0.20 mm. G/GA.



TOOL No.	NOM. SIEZ	'GO'	'NOT GO' DIA.
G/GA-166/1	38. + .011 .005	38.011	37.995
G/GA-166/2	38.20 ,,	38.211	38.195
G/GA-166/3	38.40 ,,	38.411	38.395
G/GA-166/4	38.60 ,,	38.611	38.595
G/GA-166/5	38.80 ,,	38.811	38.795
G/GA-166/6	39.00 ,,	39.011	38.995
G/GA-166/7	39.20	39.211	39.195
G/GA-166/8	39.40	39.411	39.395
G/GA-166/9	39.60	39.611	39.595
G/GA-166/10	39.80	39.811	39.795
G/GA-166/11	40.00	40.011	39.995
G/GA-166/12	40.20	40.211	40.195
G/GA-166/13	40.40	40.411	40.395
G/GA-166/14	40.60	40.611	40.595
G/GA-166/15	40.80	40.811	40.795
G/GA-166/16	41.00	41.011	40.995
G/GA-166/17	41.20	41.211	41.195
G/GA-166/18	41.40	41.411	41.395
G/GA-166/19	41.60	41.611	41.595
G/GA-166/20	41.80	41.811	41.795
G/GA-166/21	42.00	42.011	41.995

Drawing Office. The limits for these are shown in Fig. 2. It needs little imagination to note that if the fixed hole is made to say, gauge G/GA-165/15, the floating hole to 166/15 and the motion pin to 167/15, we would get the limits and fits that we are aiming at, for that particular location.

A simple procedure was therefore laid down to ensure accurate compilation of the pre-inspection report and proper post-inspection rectification.

When the motion pins are received in the inspection booth, after caustic cleaning in the Bosh tank, the inspector would check each link as indicated below:

(a) He would insert the smallest plug gauge (i.e. G/GA-164/1) in the fixed hole of the link. If the "GO" end of the gauge went in, he would insert progressively higher diameter gauges till he came across a particular gauge whose "GO" end did not enter the fixed hole. Suppose G/GA-164/4 was the first gauge whose 'GO' end did not enter, he would indicate the size of the next higher diameter gauge (viz. G/GA-164/5) on the inspection sheet for that fixed hole. He would then specify the size of motion pin for this particular hole (in this case G/GA-166/5) and the gauge for the floating hole in the butt end (G/GA 166/5)

(b) He would complete the pre-inspection sheet in this manner. A complete one is shown in Fig. 3.

(c) The inspection sheet forms the basis for subsequent operations on the links, viz.,—internal grinding of fixed and floating holes and centreless grinding of motion pins.

The above procedure thus ensures in a fool-proof manner, adherence to the proper limits and fits.●●●

Standard Data For Guillotine Shearing Machine

Samir Kumar Roy*

In order to determine the standard time for shearing sheets and plates in the guillotine shearing machine having a rated capacity of 17/64″, a system of standard data was built up in the Eastern Railway C & W Shops at Kanchrapara. The author does not claim that the standard thus built up is the best one possible. Like any pioneering procedure, it is presented here as "food for thought" to others who may contemplate building standards of a similar nature.

SIX ELEMENTS ARE INVOLVED IN THE OPERATION of the shearing machine. They are :

(i) *Loading* : Bringing a plate or sheet from the nearby stack and placing it over a set of ball transfers fixed in front of the machine for feeding into the machine. While handling of sheets upto 1/8″ is done manually, those of thickness over 1/8″ are handled with the help of a pneumatic hoist, thus requiring two sets of standards for meeting the requirements of the situation.

Occasionally an already cut piece is brought from the hind side of the machine and re-loaded on ball transfers for further sizing.

(ii) *Unloading*: Removal of left-over pieces from the ball transfers after completion of the shearing to another nearby stack. This unloaded piece may either be a sized sheet or an off cut.

iii) *Turning Sides* : Sometimes after shearing the excess material lengthwise, the sheet is turned round through 90 degrees for sizing up widthwise.

iv) *Setting to Stop* : Pushing the sheet over the ball transfers into the machine until its edge touches a stop set at a desired distance for the purpose of correct positioning under shear blade.

(v) *Setting to Mark* : Positioning a sheet under the shear blade, keeping the marking on the sheet in line with the cutting edge of the blade.

Constant Element

(vi) *Shearing* : By pressing a button on the control panel, the hold down

* Eastern Railway Workshops, Kanchrapara. The author had prepared this article with a prologue on Time Study. It is printed after the article as an Appendix.

plungers drop and press the sheet over the table. the shear blade drops thereafter and cuts the sheet. The plungers and the blade automatically return to their respective positions immediately after shearing. Continuous strokes of the plungers and shear blade can also be obtained for shearing a number of narrow strips of the same size from a single sheet by pressing another button.

Development of Standard

As many as 24 time studies, each containing approximately 20 cycles on an average, have been taken—covering all the variable elements. Sheets and plates of varying thicknesses between 1/16" to 1/4" and of various sizes ranging from 1.05 to 52 sq. ft. have been covered by the aforesaid time studies. The results obtained therefrom have been summarised in Table 1.

Basic times corresponding to the various sizes of sheets as obtained from the time studies have been plotted in graphs, and separate lines representing different elements of work have thus been obtained. Two sets of lines have been drawn in separate graphs for sheets up to 1/8" thickness and for those of thickness over 1/8" as shown in figures 1 and 2 respectively. It may be seen from Table 1 that while basic times for loading, unloading and turning have varied quite considerably for variations in the size of sheets, there has not been any appreciable variation in basic times for setting either to mark or to stop for similar variations in the size of sheets. Therefore, arithmetical average of the basic times obtained from different studies has been taken as the representative basic time for sheets of all sizes in case of those two elements. Straight lines representing the two elements under consideration have also been drawn paralled to abcissa in both the graphs.

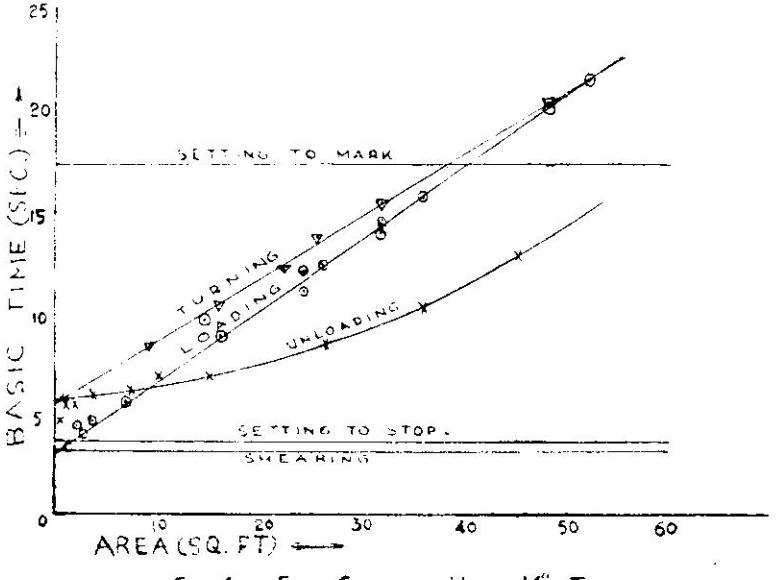


FIG-1 :- FOR SHEETS UPTO 1/8" THICKNESS

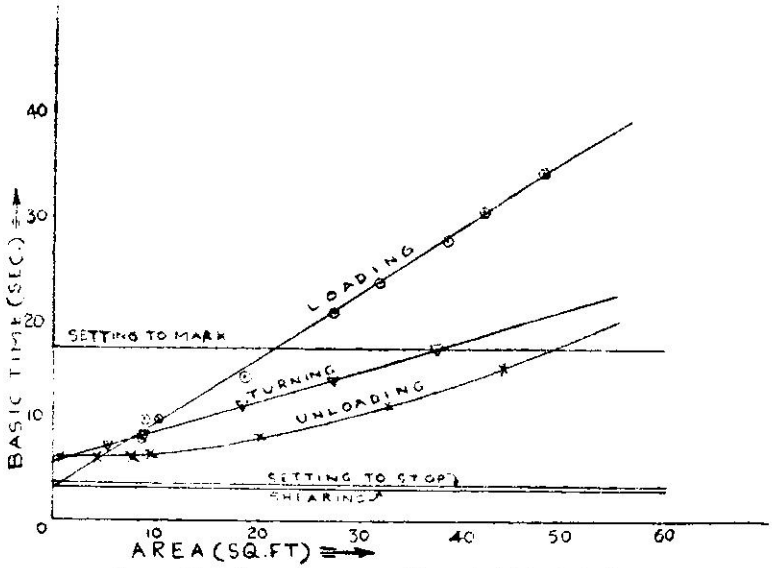


FIG- 2 :- FOR SHEETS OVER 1/8" TO 1/4" THICKNESS

The basic time for the only constant element in the entire operation cycle, viz., Shearing, has been found out by calculation as under :-

Basic time for each stroke of shear blade—

$$= \frac{1}{\text{No of strokes per minute}} \text{ mts}$$

$$= \frac{1}{18} \text{ mts} = .056 \text{ mts or } 3.3 \text{ Secs.}$$

A straight line representing 'shearing' has also been incorporated in each of the two graphs. Thus the basic time for any element of work involved in shearing sheet of any size upto 52 Sq. ft. area and of thickness upto 1/4" can be accurately read from the graphs.

Alternatively, sheets of various sizes are divided into a suitable number of groups and a representative basic time for sheets of all sizes within the group is found out by taking the mean of the basic times of the smallest and the largest sheet falling in that group. Thus different sets of representative basic times corresponding to different size groups are found out separately for various elements and tabulated in the form of a chart. (Table 1.)

A similar chart for the guillotine shearing machine under consideration has been prepared for various elements and varying thickness. (Table 2)

Standard times for all shearing operations performed on the machine in question can be found out through synthesis of predetermined element basic times as obtainable from the chart.

Application of the Standard

A sample computation sheet wherein standard time for shearing 3'-2 1/4" x 3'-2" x 1/8" pieces from a 8'-0"x 4'-0" x 1/8" sheet has been found out with the help of the aforesaid elemental time standards, has been shown in Table 3.

TABLE

For Sheets up to

Variable elements	Study No.	1	2	3	4	5	6	7	8	9
	Basic time (Secs)	21.5	12.2	14.0	9.0	15.7	14.3	9.7	14.6	4.7
Loading	Area (sq. ft)	52	24	32	16	36	32	14.46	32	3.64
Unloading	Basic Time (Secs)	13.0				(i) 6.2 (ii) 7.2	7.0	6	8.6	5.5
	Area (sq. ft)	45				(i) 6 (ii) 15	10.05	3.61	26.28	1.92
Turning	Basic time (Secs)	20.4	12.3	(i) 15.5 (ii) 10.5			13.86			
	Area (sq. ft)	48	22	(i) 32 (ii) 16			25.28			
Setting to stop	Basic time (Secs)	5.0		4.3	3.5					
Setting to marking	Basic time (Secs)		16.9	18.63		18.39	17.27	16.8	18.07	17.4

Average Basic

(i) For setting to stop

(ii) For setting to mark

I

1/8" Thickness							For Sheets over 1/8" to 1/4" thickness							
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
11.35	4.5	4.1	12.5	3.45	5.6	20.1	23.8	10.1	(i) 30.1 (ii) 8.1	27.7	14.7	10.1	20.8	34
24	2.05	2.8	26	1.05	6.75	48	32	10.24	(i) 42 (ii) 8.72	38.6	18.8	9	27.42	48
5.8	5.5	5.8	5.8	4.8		10.4	6.6	6.2	(i) 11.5 (ii) 6.2	8.2	6.3	6.3	6.2	15.4
1.24	1.12	0.63	0.97	0.39		36	9.48	0.82	(i) 33.18 (ii) 7.5	20	4.38	4.41	0.59	44
										17.2	(i) 11.4 (ii) 7.5	8.5	14.1	
										37.6	(i) 18.4 (ii) 5.3	8.83	27.3	
3.3	3.0	3.1	4.6	3.2	3.35	3.9	3.6	4.1	3.23	3.3	3.32	3.4	4.3	3.7
			17.0						16.5	18.5		16.3	17.05	

Time

= 3.68 Secs.

= 17.4 Secs

TABLE II

ELEMENT TIME STANDARDS FOR G SHEARING MACHINE

Basic Time in Seconds

AREA	ELEMENTS	Upte 1/8" thick	Over 1/8" to 1/4" thick
Upto 16 Sq. ft.	Loading	6.1	8.7
	Unloading	6.4	6.9
	Turning	8.0	8.4
Over 16	Loading	11.8	18.7
to 32 Sq. ft.	Unloading	8.3	9.4
	Turning	13.0	13.2
OVER 32 Sq. ft.	Loading	17.4	28.8
	Unloading	11.9	14.2
	Turning	18.0	18.0
ALL	Setting to stop	3.7	
ALL	Setting to mark	17.4	
ALL	Shearing	3.3	

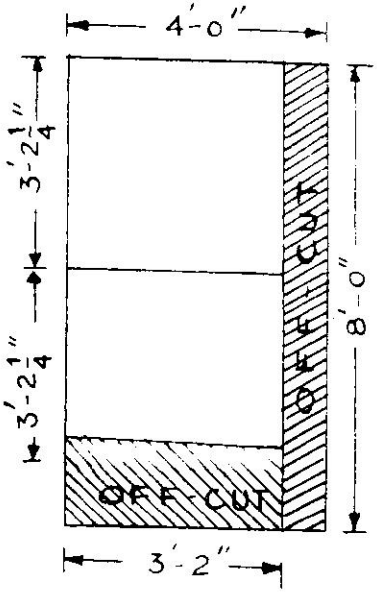
TABLE III

EASTERN RAILWAY

C & W SHOPS - KANCHRAPARA

Computation Sheet—Guillotine Shearing Machine

Regn. No. : TC 87 dt. 9-3-67 | P.L. No. EB2/SPL | Drg. : No. TCU-077 Fig : A
Raw material size : 8' 0" 4' 0" ¼" | Finish : Size 3' -2¼" × 3' -2" × ½" | No. : Sheet 2
Operation No. 1 | Operation : Shear sheet to size
Deptt. : Shop 20 | Machine : G Shearing | Machine Code : PS



ELEMENTS	SIZE	Unit basic time (Secs)	No.	Total time (Sec)	
Load	Upto 16 sq. ft.				
	Over 16 sq. ft. to 32 sq. ft.	11.8	1	11.8	
	Over 32 sq. ft.				
	Total time for loading				11.8
Turn	Upto 16 sq. ft.				
	Over 16 sq. ft. to 32 sq. ft.	13.0	1	13.0	
	Over 32 sq. ft.				
	Total time for unloading				13.0
Unload	Upto 16 sq. ft.	6.4	1	6.4	
	Over 16 sq. ft. to 32 sq. ft.				
	Over 32 sq. ft.				
	Total time for unloading				6.4
Setting & Shearing	Setting to mark	17.4	1	17.4	
	Setting to stop	3.7	2	7.4	
	Shearing	3.3	3	9.9	
	Total time for setting & shearing				34.7
	Total Basic time				65.9
Total standard time by adding 87.5% allowance					123.5 Secs.

Allowed time : 02 mts. 35 secs. for 2 Nos. | Issued time : 00 hrs. 11 mts. for TEN

		Allowed time	No.	Total P.A.
Preparation Allowance per batch	Setting up step	15 mts. per occasion	1	00 hrs—15 mts.

Use of standard data has minimised work of time study to a great extent. Determination of standard time for an operation takes only a few minutes by computation from the data which would have taken hours or even days to determine the same by time study. Further, standard time for an operation can be found out by computation before the operation actually takes place, thereby making it possible to prepare accurate estimates. It helps in making a choice of the most economical method out of several methods of performing an operation as is required in the development stage in a method study project. However, use of standard data should be made by persons trained by an expert, in order to avoid errors.

Conclusion

When applying standard data hardly any single standard is exactly right, but over several jobs the average is correct. The degree of inaccuracy of any one standard depends upon the degree of detail in which the data have been prepared.

Appendix on Time Study

THE importance of more and better measurement in the organisation and control of human activity directed to specific ends needs hardly any emphasis. It was Galileo who first realised the importance of measurement when he wrote :

'Count' what is countable
Measure what is measurable
And what is not measurable
Make measurable.

The study which is the basic technique of work measurement is often regarded as a costly affair. It is, however, possible to cut the cost of time study by using its results over and over again. This, in effect, means building up elemental standards for a type of work. These are, in fact, tables of predetermined time values created by studying a representative number of operations for the range of work normally encountered on a particular machine and then using simple arithmetic treatment as a means of preparing sets of values to cover all the expected range of work elements.

Types of Elements

When compiling standard data, two types of elements are generally encountered. These are called constants and variables. In constants, the rated or normal time is always the same regardless of the characteristics of the part being worked upon, as long as the method and the working conditions remain unchanged. Thus drilling hole with a drill of 1" diameter upto 1/2" depth is a constant element because the rated time for completing the work is the same on every occasion as long as the same speed and feed is engaged.

In case of variables, the rated time under the same methods and working conditions will change because of the varying characteristic of the parts being worked upon, for example, size weight, shape etc.

In case of machine work, a constant element is represented by one which is performed exclusively by machine whereas a variable element is usually the one which is performed partly or wholly by human effort.

In compiling standard data, it is the variables which control its completion and for that purpose careful representative studies throughout the complete range of variable elements are vitally necessary for better results.●●●

Modern Concept of Cost Control

Lt. Col. TP Srivastava*
&
Ishwar Chandra Dogra*

In any enterprise, whether a business or a construction project, the technique of budgetary control plays a vital part and cannot be taken lightly. During the last war (1942-45) many projects, involving production and development, were undertaken. A later study revealed that *in most cases the limits of both time and cost had been exceeded.* A study of present day projects would indicate much the same position. From the point of view of the public interest, the enormous financial outlays, the urgent need to spread resources over a very wide area, and above all the dire necessity to accomplish a sizeable job of development within limited time, this cannot be called a satisfactory state of affairs; and one can hardly be complacent about it under the circumstances that prevail.

THERE ARE A SET OF PRINCIPLES LAID DOWN for Budgetary and Cost Control :

(a) *A Good Plan:* The success of a project hinges on the plan drawn for its execution. So does the cost. A sound workable plan, purposively designed for making the maximum use of available resources and timed for completion in the most economical period, is a *must.*

(b) *Measurements:* A good plan can yield good results only if it is executed according to schedule. To ensure this, it is necessary to ascertain, at every stage, that progress is being made in accordance with the plan. If the rate of progress laid down in the plan has not been maintained, the divergence must be recorded.

(c) *Investigation*: When the measurements show a divergence, it is imperative to know the reasons. By investigation, these reasons come to light.

(d) *Corrective Action:* Once the reason for divergence is known, action can be taken to correct the slip and remedy shortcomings of the plan. Corrective action may not be warranted in each and every case of divergence, but where it is learnt that the slip is because of weaknesses, such that they will affect cost and time in future as well, action must be taken without any delay.

In this paper we will discuss a system or a method by which strict Budgetary and Cost Control in the execution of a project can be enforced, right from the very beginning. The system will be dealt with in two parts: Part I dealing with planning and Part II with measurements and control. For the sake of clarity of the principles, transactions of the following three departments of a production centre are given precisely:

*Dte. General of Border Roads

(a) Machine Shop

(b) Grinding Department

(c) Service Department

Part I — Planning

It has been found that the cost of a project is closely related to its completion time. The relation of cost to completion time is given by the graph in Fig. 1. It is evident that the yard-stick rate can only be a guide for the purpose of pricing a project. It may not always give the true and accurate financial position of the project and its cost. Each and every project must, therefore, be costed individually for the specified period of completion.

From the graph it will be seen that a project costs maximum, if it is completed in record (crash) time and minimum if in the normal course. There may be factors, which may overrule economical completion, but if there are no such governing factors, a project must be timed for completion at minimum cost.

The first and the foremost problem in planning a project is, therefore, to find out the most economical period of completion. Total cost of a project comprises of two elements.

(a) Direct cost

(b) Indirect cost

Direct Cost

This is the cost for directly employing men and machines on the job and the cost of all materials, including the wastage, that is incorporated in the work. This is arrived at, by summation of the direct costs of all the activities.

Direct cost of an activity is represented by the curve given in Fig. 2. This curve is always a concave one. There are two important points on this curve :

(a) Crash time crash cost (marked C)

(b) Normal time normal cost (marked N)

The rate of change in the cost of the activity is given by the slope of the curve and is called the cost slope. This slope is not constant and varies from point to point. The variations in cost slopes may be represented by different cost slopes, say S_1, S_2, S_3 as in Fig. 2.

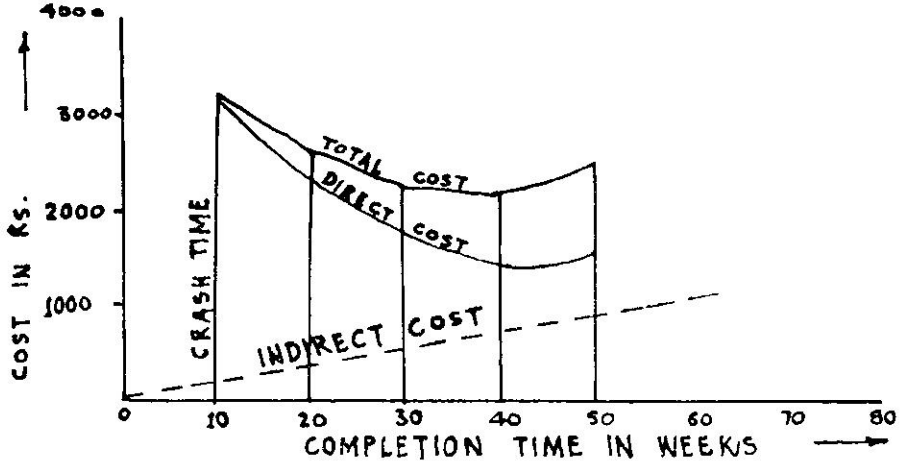


FIG 1 COST CURVE OF A PROJECT

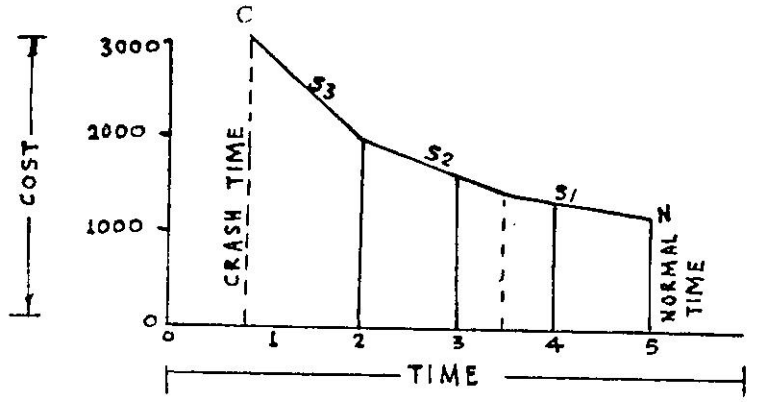


FIG-2 DIRECT COST OF AN ACTIVITY

Now the various activities involved in the aforesaid production centre may be outlined as below :

Machine Shop and Grinding Department

(a) Procuring alloy steel
(b) Cutting alloy to required sizes
(c) Turning on centre lathe
(d) Milling
(e) Grinding in grinding department

Service Department

(a) Provision of maintenance crew
(b) Provision of fuel & power

The records of activities and their costing may vary from project to project. In the costing of above activities, the expenditure on service department will be taken as an indirect cost and apportioned to Machine Shop and the grinding department in the ratio of the expenditures incurred on the two departments.

The various events for the performance of activities (a) to (e) given above will be as under:

1. Purchase requisitioned
2. Alloy procured
3. Alloy cut to required sizes
4. Turned on centre lathes
5. Milled and
6. Ground

The above activities render their performance in chain and the Network plan will appear as in Fig. 3.

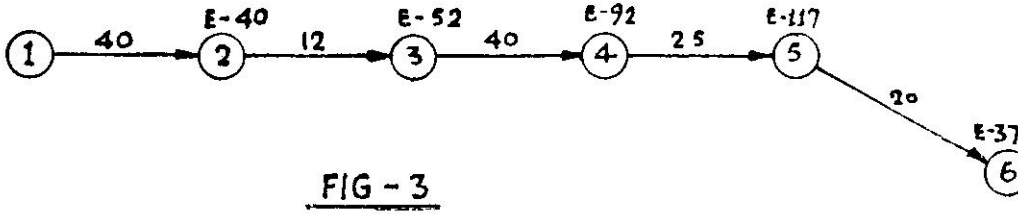


FIG - 3

How is the direct cost curve for the project drawn?

Once the network plan for the project is finalised, direct cost curve for each activity is drawn and the following are determined :

(a) Crash time crash cost

(b) Normal time normal cost

(c) Cost slope.

Since the cost slope of an activity differs from one range of completion time to another, it may be necessary to adopt more than one cost slope for one activity while compressing and decompressing the network. If, however, the difference between the cost slopes is not too high, it may suffice in most of the cases to adopt only one slope. The results thus obtained will be approximate, but fairly satisfactory.

The information thus obtained is shown in Table 1.

The network plan drawn for the project is then compressed and decompressed for various periods of completion and with the help of information available in Table I direct completion costs for each of these periods of completion are worked out. The completion times with the corresponding costs are plotted as nodes and joined in succession to give the direct cost curve of the network. It may appear to be a very cumbersome process but with experience, work can be minimised by combining many activities into one. Individual independent portions of a network model can be replaced by a single activity (works package), provided interference occurs only at its beginning and termination nodes. A network plan for a project is shown in Fig. 4.

The time taken by the plan is 39 days. This time is along two critical paths 1,2,5,7,9 and 1,2,5,8,9. The cost of the project for 39 days completion is Rs. 71,300/-. In carrying out compression, occasion may arise when more than one activity may have to be crashed. Compression in such cases is to be carried out in stages, and the final stage of compression will accrue when activities along the critical paths are fully crashed.

The time for the above project was reduced to 28 days and the network plan after the 6th compression appeared as shown in Fig. 5.

TABLE I

ACTIVITIES TIME/COST DATA

PROJECT: Manufacture of an Alloy Product

S. No.	Activity No.	Activity Description	Normal		Crash Time		Cost Slope	Remarks
			Duration Days	Cost Rs.	Duration Days	Cost Rs.		
a	b	c	d	e	f	g	h	i
1	1 - 2	Procure Alloy Steel	40	9440/-	20	11940/-	125	80 Mandays for
2	2 - 3	Break Alloy	12	2216/-	4	2936/-	90	Storage &
3	3 - 4	Turn	40	4715/-	15	5475/-	50	Handling
4	4 - 5	Mill	25	2425/-	10	3425/-	100	220 Mandays
5	5 - 6	Grind	20	1660/-	6	2110/-	75	for Cutting

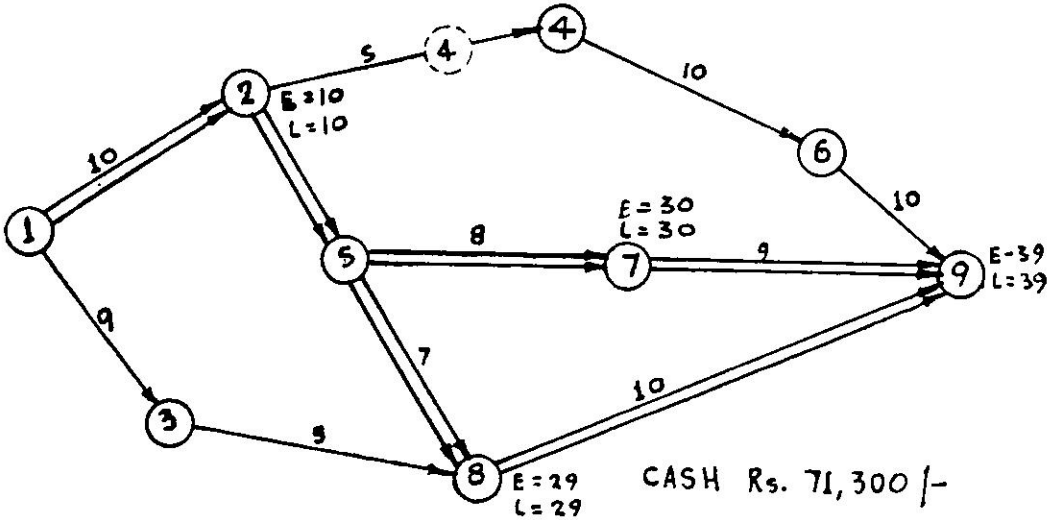


FIG-4

Indirect Cost

This is the cost of all administrative tail, idle resources, overhead which is not directly related to the job as such, but is necessary for supervision, safeguarding stores and its handling and is to be paid for. Expenditure on these items is generally of a recurring nature and the graph is generally a straight line, increasing in proportion to the period of completion. This graph can, therefore, be easily drawn once the recurring expenditure is worked out.

Total Cost Curve

The direct and indirect cost elements are then integrated and the total cost curve is plotted. From this total cost curve, the most economical period of completion is determined and the network plan is scheduled for completion accordingly. The process of determining the economical period of completion is necessary, only in cases, where taking into consideration other factors, the period of completion has not already been specified. In the cases, where it has been specified, the network plan from the beginning is to be scheduled for the specified period of completion. Finalised Network plan will depend upon the project which is being planned. A network plan for the above project for 30 days completion is as in Fig. 6.

Having worked out the logic of the plan and having determined its period of completion, the next step is to prepare the cost plan of the project as a whole. Before we decide as to how a cost plan be worked out, it is important to bear in mind as to what information one would like to have available, in order to prepare the budget, notice divergence, if any, and be in a position to take corrective action.

The set of information that should be available from the plan is :

(a) Total cost of the project

(b) Phase-wise cost of the project (if in phases)

(c) Period-wise cost of the project

(d) Item-wise cost of the project

(e) Cost centre-wise cost of the project

(f) Maximum draw of capital at any time (investments) or periodical payments.

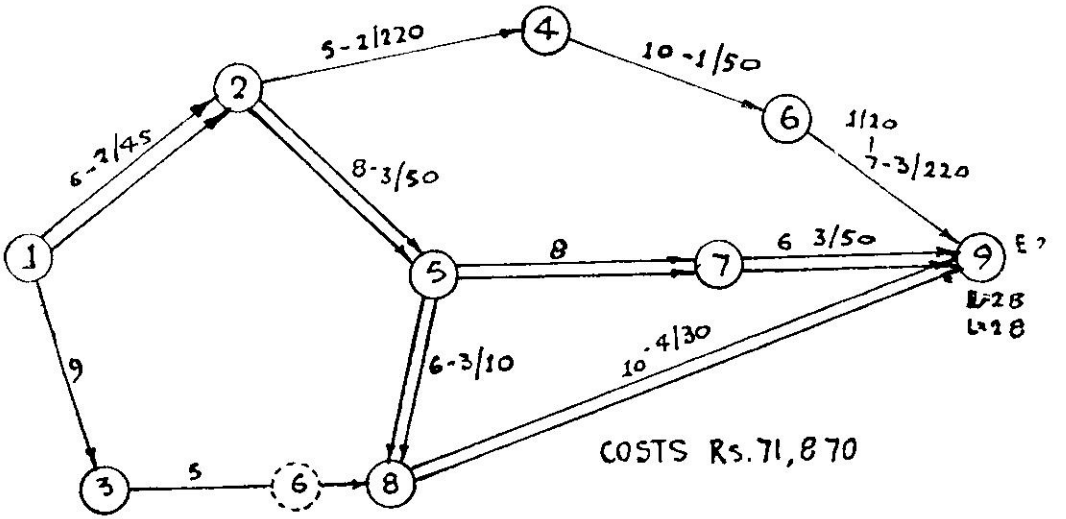


FIG - 5

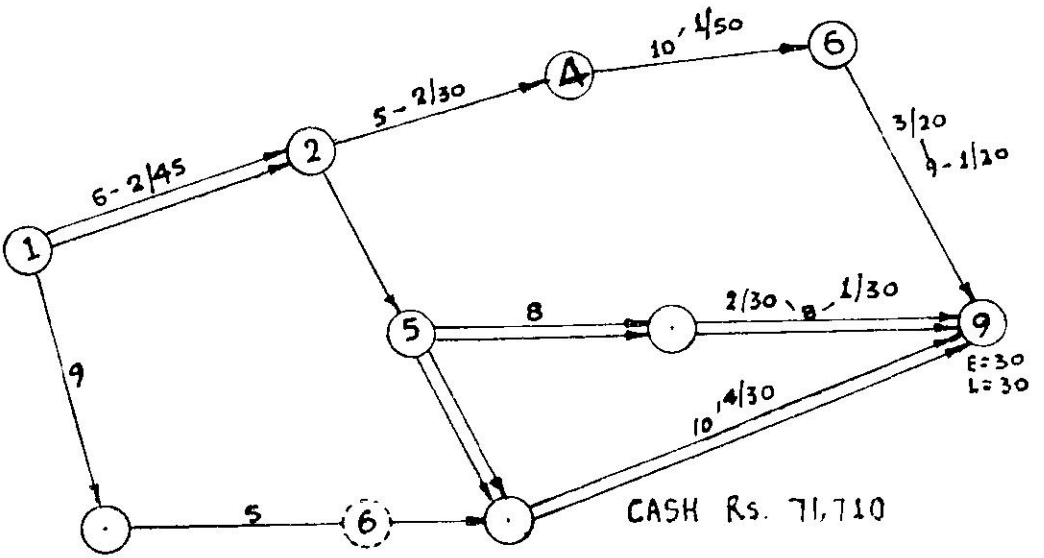


FIG-6. NETWORK PLAN

Once the finalised network is scheduled for execution, the time schedule can be given either by dates to each activity or by projecting the network on to a time scale. For costing purpose, projecting the network to a time scale is necessary because from this projected plan, the activities, carried out concurrently, can be clearly seen and their cost directly totalled up for knowing the period-wise cost.

Having projected the network plan to a time schedule, the loading of resources is worked out and the histogram as in Fig. 7 is drawn. Histogram is necessary only if idle resources (machinery) affect the cost. In that case histogram for each of the resources that affect the cost must be drawn. In projects where the resources have already been allotted and hiring charges or idle charges are paid for irrespective of using or otherwise, the histogram is a *must* to determine indirect cost element on account of idle resources.

Phase-wise Execution

In case of projects which are to be executed in phases, separate planning is done for each individual phase. Network plan for each phase is accordingly drawn and details as necessary for costing purpose of a phase are worked out from each phase plan. Indirect cost can be suitably apportioned to each phase. To bring out the mechanics of cost control, costing of only one phase of the plan is discussed here.

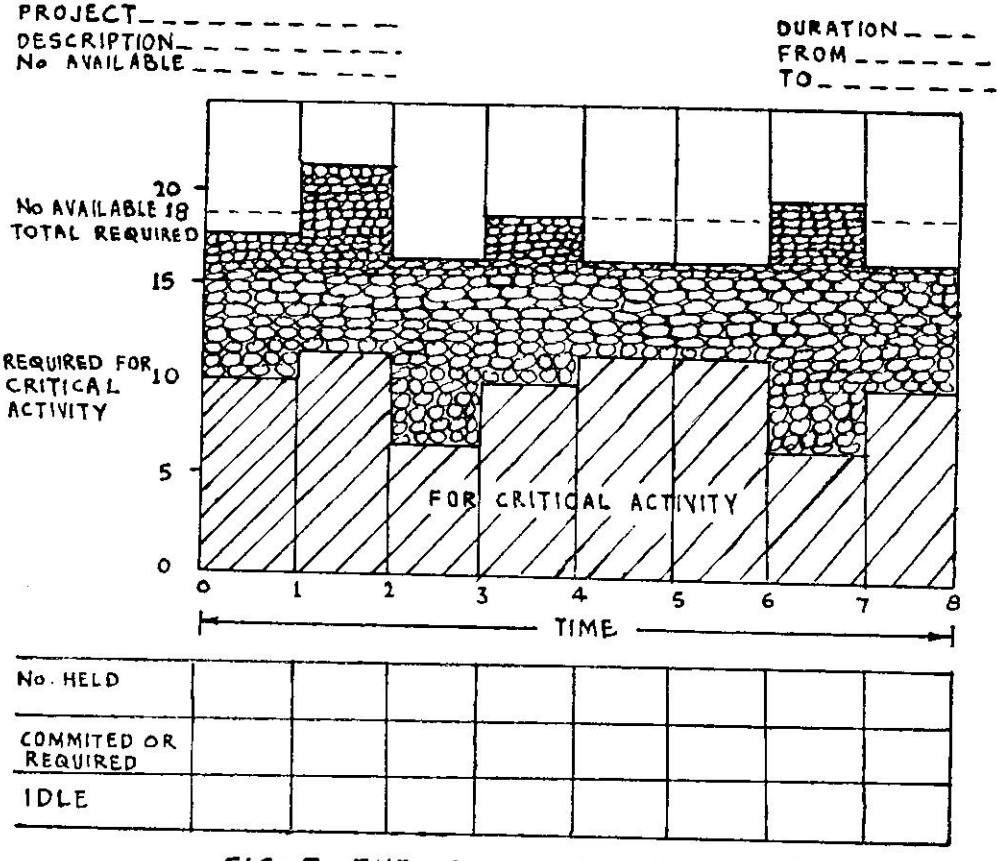


FIG. 7 TYPICAL LOADING GRAPH

Costing the Plan

To work out the total cost of a project, costing of the plan is done as described below. This is necessary so that the information as sought for in the plan is readily available and also the item on which divergence has occurred is singled out. If any of the information already listed above is not required, step for costing that information can be omitted.

Activity Costing

Each and every item of work or activity that is necessary to complete the job must be priced. It will include cost of all material actually to be incorporated in the item including the accepted wastage, pay and allowances of all men to be actually and directly employed on the item and expenditure on account of running and maintenance of all machines to be used. Most information with regard to pricing of an activity is already available in Table 1. Based on this information Activity Costing Chart as in Table 2 is prepared. The Chart gives the information on item-wise cost of the project as well as cost centre-wise cost of the item. Both these informations are of immense value in analysing any divergence and knowing the cause of slip.

It is worth the trouble to consider idle resource and indirect cost also as activities in the Activity Costing Schedule. Firstly, because the total cost of the project is drawn up side by side in this schedule and secondly the incidence of each item, idle resources and indirect cost, on the total cost, is reflected. Whether items of indirect cost are grouped into one or more would depend on the degree

TABLE II

ACTIVITY COSTING SCHEDULE

PROJECT: Manufacture of an Alloy Product

S. No.	Activity No.	Activity Description		Resources Required Cost Centrewise — Man Power Rate	Materials Rate	Machine Rate		Total cost of Activity Rs.
1	1—2	Procure Alloy Steel	R	80 @ 8/-	8 ton @ 1100/-	—	—	
			C	640/-	8800/-	—	—	9,440/-
2	2—3	Cut to sizes	R	220 @ 8/-	Pol 96 Lit @ 1/-	12 @ 30/-	—	
			C	1760/-	96/-	360/-	—	2,216/-
3	3—4	Turn	R	340/- @ 10/-	Power	40 @ 30/-	—	
			C	3400/-	125/-	1200/-	—	4,725/-
4	4—5	Mill	R	160 @ 10/-	Power	25 @ 30/-	—	
			C	1600/-	75/-	750/-	—	2,425/-
5	5—6	Grind	R	100 @ 10/-	Power	20 @ 30/-	—	
			C	1000/-	60/-	600/-	—	1,660/-
		Idle Resources		8400/-	9156/-	2910/-	Total	20,466/-
				280/-	—	350/-	Activity Cost	630/-
		Indirect cost		3200/-	1500/-	2500/-		7200/-
Total Cost of Project								7830/- 28,296/-

R = Required
C = Cost

of control desired. Normally showing all in a group will suffice.

Network Costing

Total cost of the project comprises of two elements, direct cost which is derived by pricing the network plan and indirect cost which is derived from pricing the proposed administrative set up and idle resources. As it would be desirable to have total cost on one schedule only, indirect cost elements must also be considered as activities and priced accordingly. The Network plan projected on to a time scale is used for pricing purpose. The Form used for pricing a plan is shown in Table 3 and this principle is illustrated by costing activities of the Network Plan shown in Fig. 4. It is assumed that weekly control by Project Manager should be carried out. This, however, varies from project to project and the level of management control. The table gives the information on total cost of project and also monthwise or periodwise as well as cost centre-wise cost of it. The information can be conveniently used for budgetary purpose.

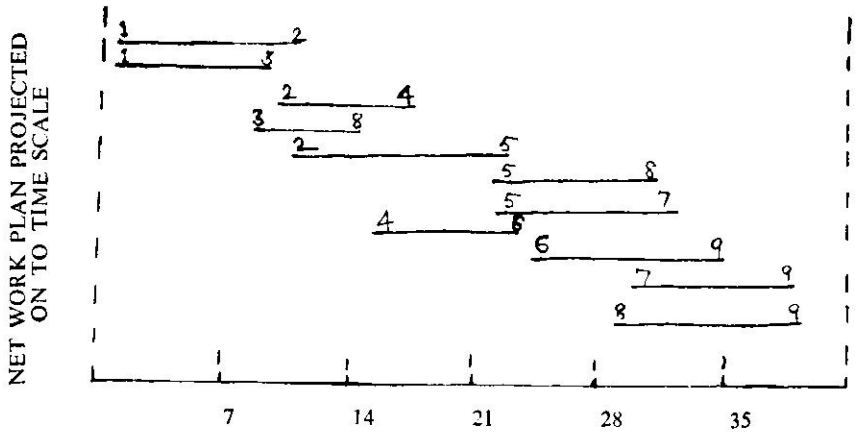
TABLE III

NETWORK COSTING SCHEDULE

Date of Start—12 Apr. '65

PROJECT: Construction of Roadside Drains

Date of Compt—20 May '65



COSTING

COST CENTRE WISE COST

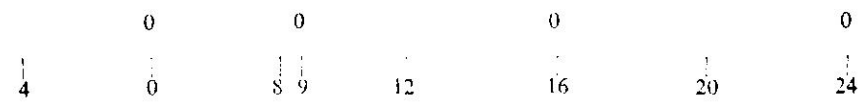
Man Power	2890.00	3755.00	3675.00	3850.00	3690.00	2640.00	20000
Machines Rs.	980.00	1230.00	1178.00	1260.00	1240.00	1112.00	1000
Materials Rs.	3870.00	4890.00	4640.00	4990.00	4880.00	4730.00	2800
Idle Resources	600.00	820.00	725.00	850.00	890.00	415.00	4300
Indirect Cost	1880	2150.00	1870.00	2160.00	2025	1415.00	1150
Total Cost	10220	12845	12088	13110	12725	10312	71300

NOTE : Period for Costing can be fixed as desired. Likewise network costing schedule is shown in Table No. IV.

TABLE IV

PROJECT : Manufacture of an Alloy Product

Date of Start 1-4-1966
Date of Completion 28-2-1967



NET WORK PLAN PROJECTED INTO TIME SCALE

Manpower	340	1560	2190	1980	1250	1080	8400
Machines	—	—	700	720	760	730	2910
Materials	—	8800	77	93	96	90	9156
Idle Resources	70	95	110	120	116	119	630
Indirect Cost	1100	1275	1170	1315	1260	1080	7200
Total Cost	1510	11,730	4247	4228	3482	3099	28296

Cost Centre-wise Costing

Cost Centre-wise information is more for statistics than for control. In case information on cost centre-wise expenditure is considered necessary, for any period, it is collated directly from the information available in Tables 2 and 4, and tabulated as suggested in Table 5 below:

TABLE V

COST CENTRE-WISE EXPENDITURE SCHEDULE

Project—Manufacture on an Alloy Product for Period—Feb. '67

Cost Centre Month/Year	Manpower		Machine		Materials		Service		Total	
	M	C	M	C	M	C	M	C	M	C
SEP. 1966	740	740	—	—	100	100	670	670	1510	1510
	610	610	—	—	110	110	740	740	1460	1460
OCT. 1966	1790	2530	—	—	9200	9300	740	1410	11730	3246
	1750	2360	—	—	10500	10610	720	1460	12970	14430
NOV. 1966	2680	5210	850	850	135	1435	582	1992	4247	17487
	2710	5270	960	960	125	10733	560	2020	4355	18785
DEC. 1966	2210	7420	910	1760	120	9555	988	2980	4228	21715
	2250	7320	1025	1985	125	10850	960	2980	4590	23135
JAN. 1967	1590	9610	895	2655	115	9670	882	3862	3482	25197
	1510	8830	875	2860	115	10965	870	3850	3370	26505
FEB. 1967	1415	10985	845	3500	110	9780	669	4521	3099	28296
	1490	10420	860	3730	115	11080	665	4515	3110	30235

Control Charts

In execution of any plan, check and control is a must and, for this purpose it is necessary to ascertain periodically the progress achieved. This is done through progress reports which may be periodical or ad hoc. In order to know any divergence the progress must be compared with the objectives laid down. For purpose of comparison and analysis of the reported progress, it is necessary to have control charts. Information from progress reports must be transferred on to these control charts for easy and direct analysis. As analysis of progress with regard to both time and expenditure is to be made, control charts containing full information of both time and cost are suggested in this paper.

Activity Control Chart

The information, that must be shown on Activity Control Chart, is as given in Table 6.

In this chart activities are listed in the order of their earliest completion time. The agency responsible for completion of the activity is also shown in case where there are more than one agency responsible for execution of the project. This facilitates investigation and also inculcates a spirit of competition between agencies. If there is only one agency this column can be omitted.

Information regarding planned, start and finish time as well as actual start and finish time have been shown on this chart so that delay can be worked out, recorded and compared with the float available for working out the slip and finding out the overall effect on the plan. All this information helps to control the timely completion of a plan.

For the purpose of cost control, the chart shows planned and actual completion cost, progress percentage with its assessed cost and actual expenditure incurred for the progress. This information helps to locate any divergence in the cost of the activity. The difference between actual expenditure incurred on any item with the assessed expenditure of progress made, signals likely divergence and calls for immediate investigation.

Expenditure Graph

Uniform expenditure or rush of expenditure is no pointer towards satisfactory Budgetary control or financial progress of any project. The most important information which is vital for financial control is whether the progress

TABLE VI

ACTIVITY CONTROL CHART

PROJECT: Manufacture of an Alloy Product

Start Date 1 Sept. 66
Completion Date 28 Feb. 67
Date Activity Started

COST
ACTIVITY BY EARLIEST COMPLETION TIME

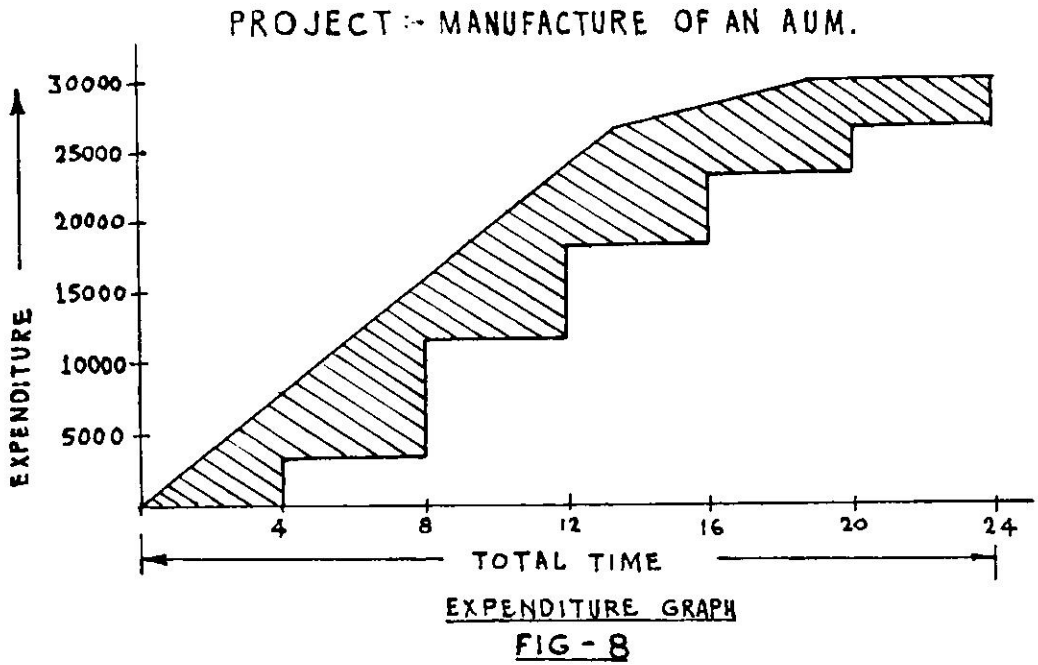
1	2	3	4		5		6	7	8		9			10
Activity No.	Activity Description	Responsibility	Planned		Actual		Delay	Float Available	Cost		Progress			Remarks
									a	b	a	b	c	
			ST	FT	ST	FT			P	A	%	Assessed Cost	Actual cost incurred	
1—2	Procure		1-9-66	19-10-66	1-9-66	6			9440	10300	90	9230	10500	
2—3	Cut to size		21-10-66	9-11-66	26-10-66	—			2216	2210	100	2236	2210	
3—4	Turn		6-11-66	26-12-66	11-11-66	—			4725	4690	100	4600	4750	
4—5	Mill		28-12-66	30-1-67	2-1-67	5			2425	2575	85	2425	2500	
5—6	Grind		31-1-67	28-2-67	9-3-67	—			1660	1750	85	1650	1750	

made is a planned return for the expenditure incurred and if not, what the likely divergence is and the effect on completion cost or profit margin if any. A divergence is readily seen on a graph and, therefore, it is suggested that a graph as given below in Fig 8 is drawn and kept for the purpose of recording expenditure.

Cost Control Charts

The chart of cost centre wise details, given in Table 6, can itself be used as a control chart. For this purpose a column of actual cost has already been incorporated in the schedule.

It is seen that in the suggested method,



EXPENDITURE GRAPH

FIG - 8

The graph shows month-wise planned expenditure which is plotted from the information available in Table 4. On this graph the curve showing payments to be made or expected as advance payments in return of progress made can also be plotted. For a contractor the area bound between two curves shown shaded in Fig. 8 is the requirement of capital at any time and maximum requirement of capital at any time can be read from this graph. For planning purpose safety margin must be maintained and Capital in excess of the requirement read on the graph must be arranged.

planning has been done for the most economical period of completion. At this stage itself all information for budgetary control is worked out and also all control charts are prepared which are necessary for easy comparison and analysis of progress.

PART II: MEASUREMENT AND CONTROL

For the purpose of weighing the achievements against the objective laid down, it is necessary to ascertain periodically the progress achieved and compare it with the targets. Progress reports are one of the means of com-

municating achievements to the management. The type of information that a progress report must contain depends on the purpose of calling it and the use it will be put to. In order that all information, that is necessary to carry out the analysis for the purpose in view, is furnished and nothing important is omitted and irrelevant information is not included, it is always necessary to lay down a set and precise progress report proforma. In this part we will discuss the proforma suggested and as to how they can be used for measurement purposes and for working out divergences. In order that only one report is rendered for both time and cost measurements, a proforma incorporating information on both aspects has been suggested throughout.

Progress Report

Information that must be given in the progress report is as suggested in Table 7. The table has been drawn to contain information in such a manner that it can be directly and readily marked on the charts maintained for control purpose.

In the proforma information such as cost, planned date of start and completion, as well as float available, has purposely been introduced so that even executives on the ground can notice the divergences and use their judgement to remedy any slip, without awaiting directions. Actual start time, anticipated finish time, percentage progress with its assessed cost and actual expenditure incurred are the actual measurements which the executive has to report. It is this measurement information that guides the project. It must therefore be compiled with accuracy and utmost care so that only the true situation of the project is reflected. It is better to have a few accurate reports after long intervals than to have more frequent but inaccurate reports.

In the progress report, actual expenditure of an activity is to be reported. Some difficulty may be felt in compiling at any particular time actual expenditure for the progress achieved on each activity. This will not be so, if accounts are regularly and correctly posted. As already stated, before furnishing any information it is always pertinent to know the purpose for which such information will be used for. It is only then that the information can be correctly com-

TABLE VII

PROJECT PROGRESS REPORT

PROJECT : —

Schedule start date.....

Actual start date.....

1	2	3	4			5	6	7	8		9
Activity No.	Activity Description	Duration	PLANNED ST	FT	Cost	Actual Anticipated	Delay	Float	PROGRESS Assessed Cost	Actual Cost	Remarks

SITUATION REPORTS IS AS ON.....

PROGRESS AND COST VERIFIED BY.....

piled. In this particular case the actual expenditure on the activity will be compared with the assessed cost of the progress made so as to know the divergence. The column of incurred expenditure must, therefore, include the incurred or anticipated cost on all items that have produced the said progress. In other words, it must include cost of all incorporated materials including their wastage, labour, machine and all other resources utilised to yield the reported progress. Whether payment on such account has been made or not is immaterial.

Cost-Centre-wise Progress Report

If the costs of activities are controlled, the cost centre-wise expenditure is automatically controlled. From measurements or control angle it is not necessary to call for cost centre-wise progress of expenditure. As already stated, it is more of a statistical requirement. It may be called for regularly or may be compiled in the end. The only advantage of calling the information regularly is to know that accounts are being maintained regularly. Moreover differences, if any, can be immediately reconciled as the facts are fresh in the mind of everyone.

Activity Accounts

Activity accounts must be posted daily and cost on account of all items utilised on that day must be entered. At the end of the month when expenditure of the activity is totalled up, cost centre-wise expenditure is also automatically given.

Working Divergence

The information given in the progress report is transferred to control charts and a comparison is made of the progress made with the objective laid down. Any achievements below the targets planned is a divergence which must be investigated, and if necessary, corrective action taken. Divergences can also be noticed on the progress report and expenditure graph.

On the Activity Control Chart (Table VI) the divergence in cost is read from columns 8 (a), (b) and 9 (b), (c). Assessed expenditure, if it is less than the actual expenditure incurred, is a pointer towards the fact that cost is exceeding on that activity, and may exceed on the project as a whole The total effect is, however, directly seen on the Expenditure graph.

So far we have plotted only two curves on the Expenditure graph.

(a) Expenditure as per plan

(b) Payments expected

The purpose of expected payment curve was to work out the investment required for the project. As the information regarding actual expenditure on activities and assessed cost of progress made is received from time to time, curves showing these informations shall also be plotted on the Expenditure graph. The postion of these curves in relation to planned expenditure curve signify the divergence in cost as well as in budget. After these two curves are plotted, the expenditure graph will appear as shown in Fig. 9.

Assessed Cost Curve

This curve represents the progress attained equated to money. Its position when compared to the other two curves, signifies as follows :

(a) *With Planned Expenditure Curve* ; Both the curves are priced on the same activity costing rate. Their interposition, therefore, signifies divergence in progress only. If the assessed cost curve is higher than the planned expenditure curve, the progress is higher than planned and vice-versa.

(b) *With Actual Expenditure Curve* : Actual expenditure curve gives the actual expenditure incurred for the progress made. Position of this with assessed cost curve which is progress converted to money signifies the divergence in the cost of the project. If assessed cost curve is higher than the incurred expenditure curve, the work is being

give a clear picture of the financial position of the programme.

Control

Control is action taken and decisions made to ensure that the plans go as much according to schedule as possible. For doing so, full information with regard to slips, if any, its impact on both time and cost, as well as reasons for occurrence must be known. From the Control Charts maintained, full information required to make decisions is always available, and timely corrective action can be taken to remedy any slip. It must, however, be clearly understood that for any degree of control, information must be specific to the requirements and accurate. There can be no short-cuts. It may be better to enforce lesser degree of controls accurately rather than to try rigid control haphazardly.

Conclusion

Completion cost of a project varies with its completion time. In order to work out a project economically, it is imperative that the project must be scheduled for minimum cost completion period. Each and every project must be individually and independently priced. Since idle resources and indirect cost generally go unnoticed and inflate the cost, it is worth considering them as activities for all costing and accounting purposes. Pricing of each item of project and at each stage, gives valuable information to enable locating a slip as soon as it occurs, for taking timely corrective action. The system discussed makes available to the management full and comprehensive information all the time, for watching and controlling the progress and cost of the project.●●●

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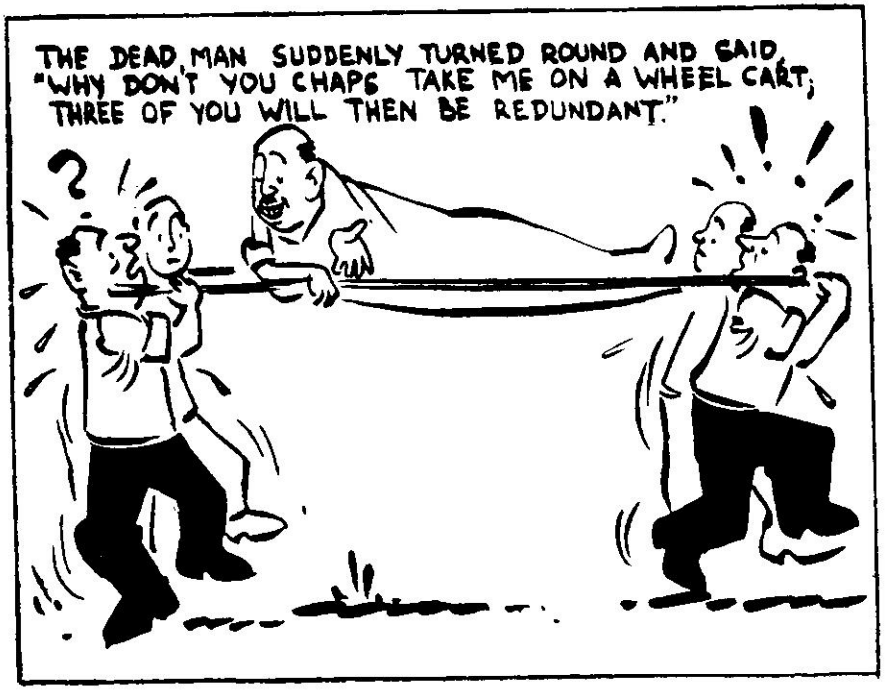

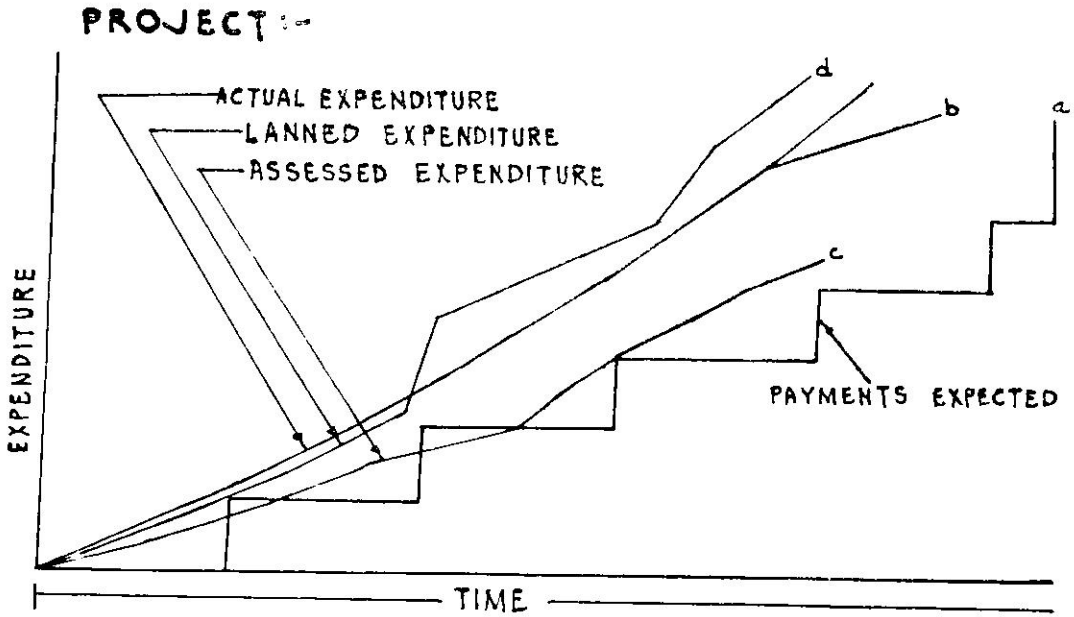

EXPENDITURE GRAPH SHOWING PROGRESS REPORT INFORMATION

FIG - 9

done at lower cost than planned and vice-versa.

Incurred Expenditure Curve

Besides signifying the divergence in the cost of the project as expalined above, the position of this curve with relation to planned expenditure curve signifies a divergence in budget and that with payment expected curve signifies divergence in investment on the project.

Planned Expenditure Curve

Since planned expenditure curve gives the financial position of the project the curve originally drawn does not hold good all the time. As soon as divergence has occurred, the planned expenditure curve must be suitably amended, to incorporate the divergence and to reflect future financial plan and commitment. Whether action has been taken to amend the plan or otherwise does not affect this correction. If the plan is changed, its financial effect will also be shown in the corrected graph.

Payments Expected Curve

This curve was originally based on expected progress. As payments expected depend solely on progress made, the curve must be amended after progress reports are received so that revised requirements of capital or investment are known. Comparison must be made of the revised expected payment curve with the revised planned expenditure ccurve, to assess actual capital investment.

Total Payment Curve

This curve represents total payments made. Its position is very significant. If it is too high, it represents blocking of capital. A periodical stock taken and study made of all curves will

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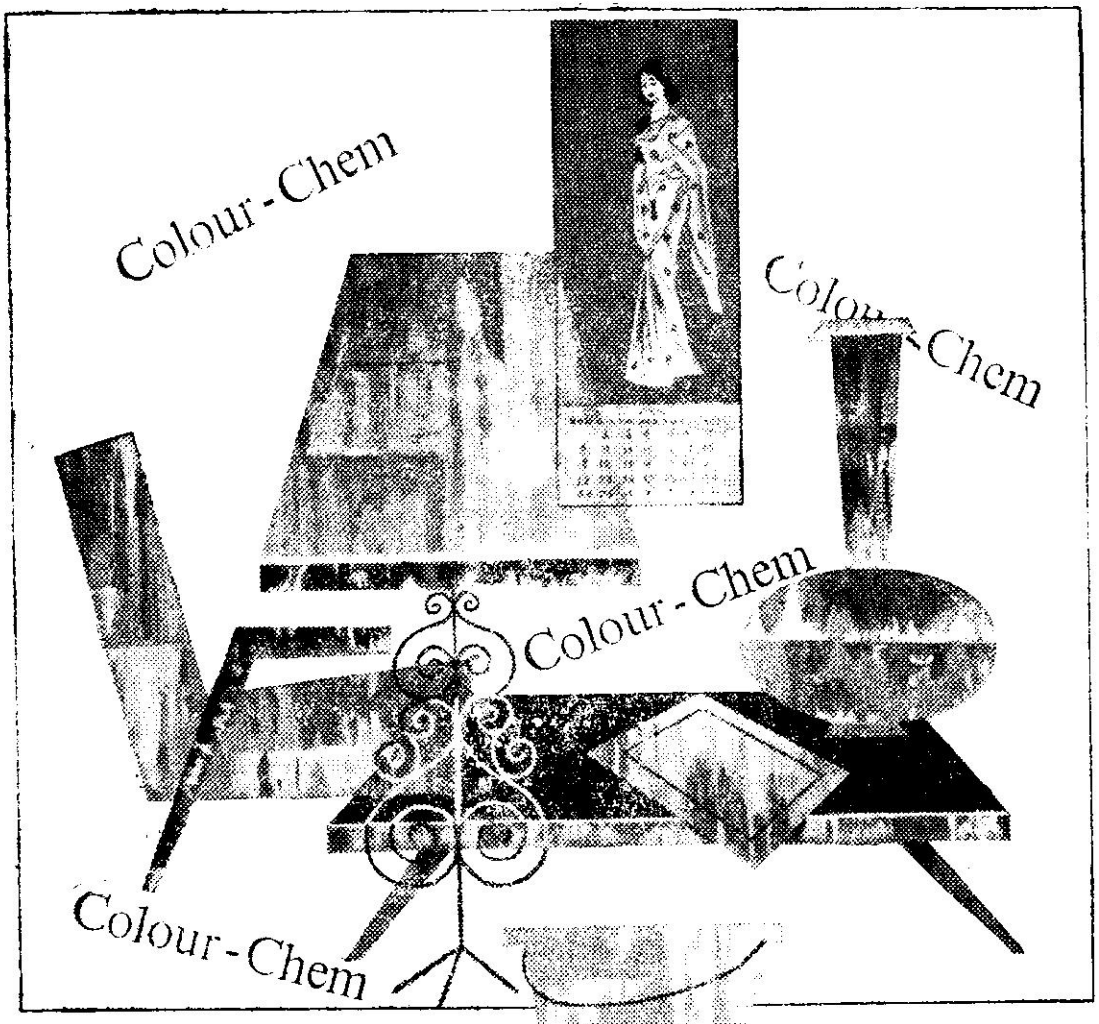

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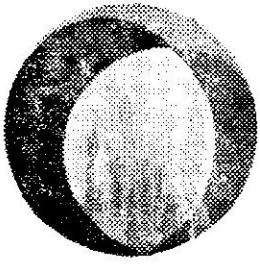

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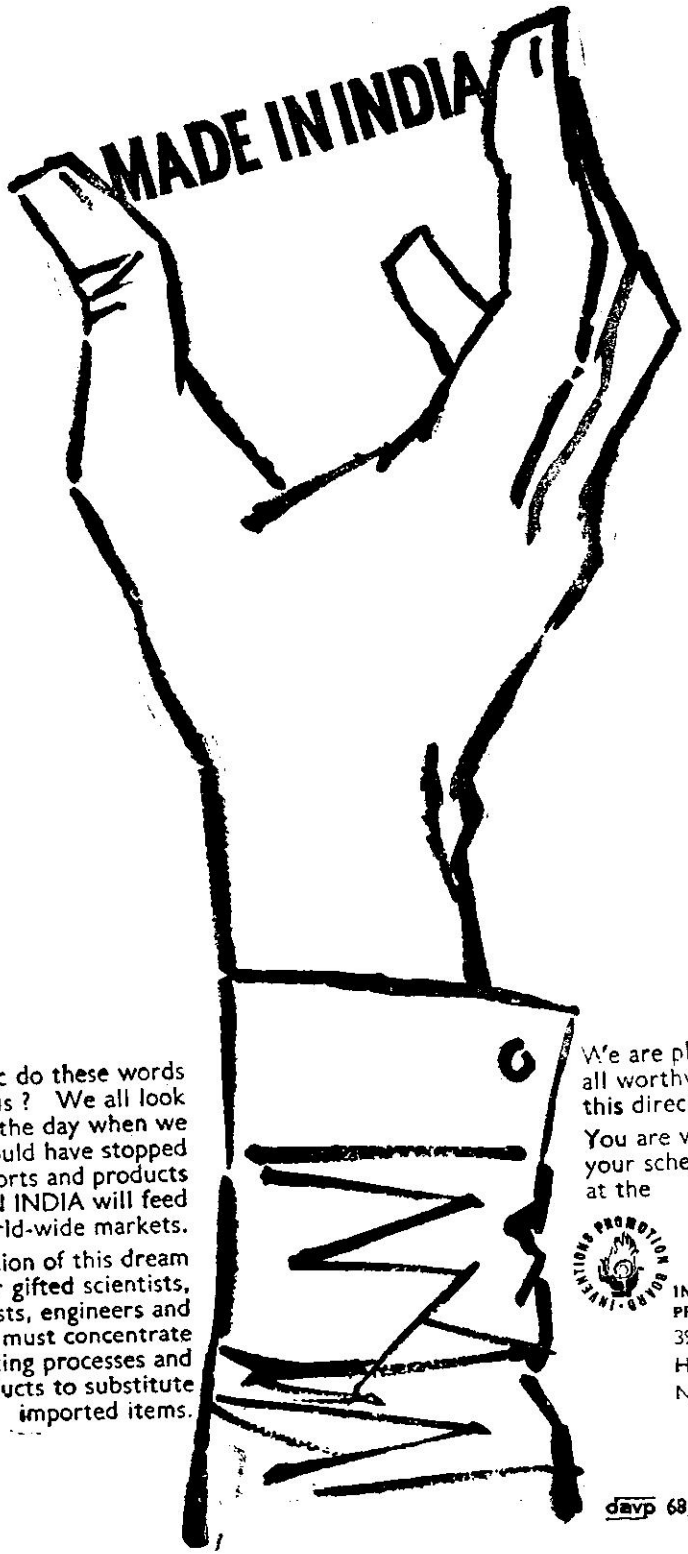

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Value Engineering	2	Sep	29
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Systematic Plant Maintenance	4	Oct	13
Selection Methods & Procedures	2	Oct	13
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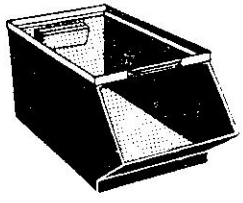

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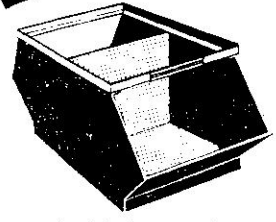

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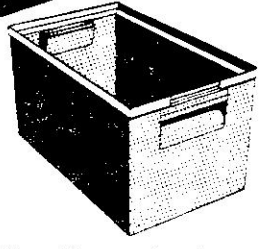

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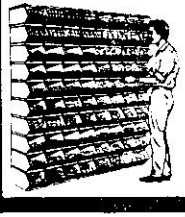

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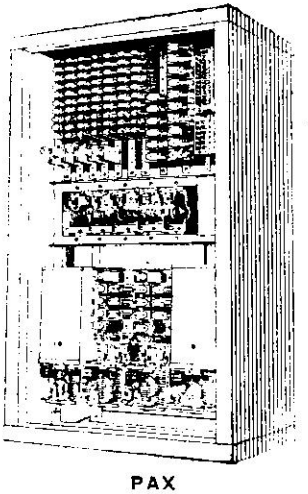

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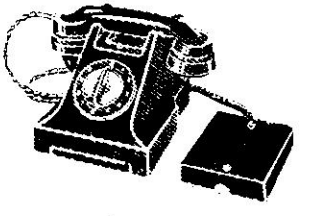

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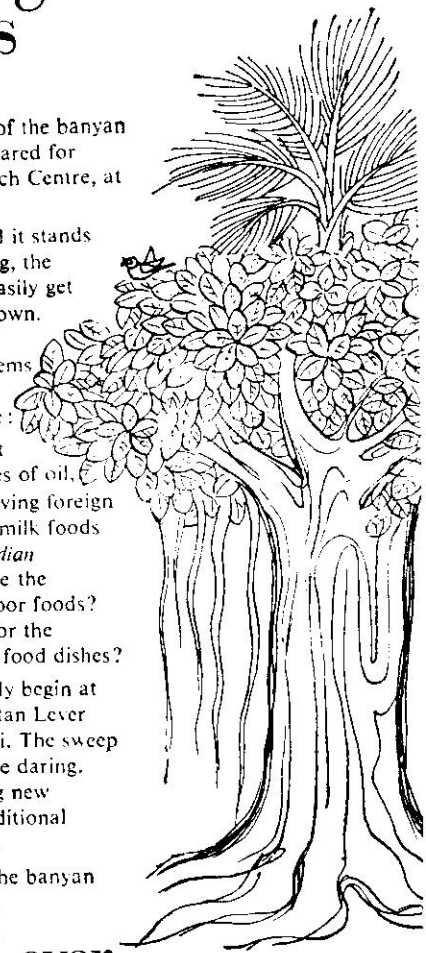

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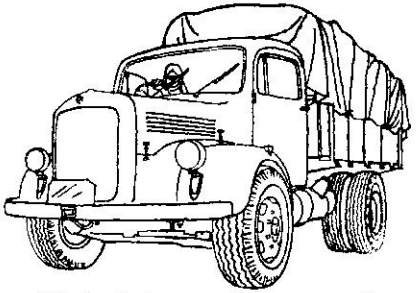

DUNLOP INDIA—*keeping pace with India's road transport*

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Problems Of Measurement†

DH Butani*

The first problem that we face in Measurement is the Problem of Change. It is like finding a fixed point of observation in outer space, when everything including the observer is whirling round constantly, and the laws of Euclidian Geometry simply do not apply, for there is no straight line between any two fixed points. Not only are the observer and the observed in constant process of dynamic change, but there is no fixed yardstick of measurement, either, for gravitation and light, which are the two bases of measurement on earth, are themselves in a process of dynamic adjustment to the push and pull of extra terrestrial forces.

IN THE MUNDANE WORLD WITH WHICH WE ARE dealing here, it is not that bad or mad, but the Problem of Change is identical. We begin to study changes in the Productivity of an Industry, say, since 1951, when the First Five Year Plan started; and we find that the particular industry, though called by the same name, is really quite a different industry, with its dominant products, vastly different in their quantities and qualities, say in 1961, more so in 1969, than in 1951. The whole industry stands transformed in its capital structure and magnitude, its techniques of manufacture, the markets from which it buys, and the markets to which it sells. What then remains of the Logic of Measurement, for the substance has, as it were, undergone a chemical change—Dr Jekyll has become Mr Hyde—but the original label of a name, the outward mark remains the same. I had drawn attention to this problem in my paper on Measurement of Productivity; and I might as well repeat‡ that I consider it of the highest importance that intellectuals should be aware of the implications of the compromise and adjustments to which statisticians are forced to resort, when compelling homogeneity, over time and space, into the vast range of their statistical material.

We, in the National Productivity Council, had to struggle with the same problem, when an Index of Industrial Productivity had to be constructed on the basis of the now vastly expanded Annual Survey of Industries, what used to be called the Census of Manufactures. Let us take the example of what is now an old industry, vegetable oils. In 1957, it covered such vast categories as edible hydrogenated oils and refined oils, and the amorphorus category "others". In 1960, these had been broken up into groundnut oil, cotton-seed oil, sesame oil, refined oil,

† This article is a resume of a lecture delivered to the Indian Statistical Service Trainees on 1 May 1969. As a Preliminary to the exposition of Problems of Measurement, a paper on 'Production and Productivity' was read for the benefit of the ISS Trainees. It is printed as an Appendix to this article.

* Director of Research and Editor NPC PRODUCTIVITY JOURNAL.

‡ The concluding passage in the paper on Measurement of Productivity reads as under :

"It is probably a matter for philosophical reflection—we economists now need it rather badly —how, as we have shown, the substance undergoes a sea change, while the names (terminology) and our scales of measurement (Productivity per manhour, etc,) remain the same. The author hopes and prays that this little acquisition by way of philosophy will teach us a bit of humility essential to intellectual integrity under blackmarket conditions."

edible hydrogenated oil, margarine, industrial hydrogenated oil, groundnut cake, cottonseed cake, sesame seed cake, soap, acid oils, oxygen, "other" products. Within four years, that is by 1964, there was further elaboration; and the following were added as products of the same industry: hard oil, press cake, deoiled cakes, solvent extracted oil, crude glycerine, distilled glycerine, tin containers, dehydrated peas and vegetables, animal feeding stuff, electricity sold, "others" (again).

Umpteen examples could be given of other industries, gloriously flowering out in the same manner, and baffling the economists to dare any valid judgment. Actually, it is neither the fault of the economists, nor of the statisticians. What is happening is a real Industrial Revolution; and the fact is that in the same category of industries, a number of industries in their own right are emerging daily; and a comparison, therefore, of Productivity and other relevant matters, becomes more a matter of trained judgment than of purely statistical formulation.

Another problem that we face in Measurement is the selection of input, for customarily we measure Productivity by dividing the output by the input. We have already seen the difficulties with regard to the heterogeneity of outputs. The difficulties with regard to inputs are more fundamental, for the purists refuse to accept the traditional method of measuring Labour Productivity; and despite all the labours that we have put in since Adam Smith to Keynes and Kuznets, we go round and round, and come back to Labour Productivity, as the only simple and understandable index of productivity.

Attempts have been made in recent years to construct an index of Total Productivity by making a hotch potch of labour, capital, fuels, electricity, entrepreneurship etc. etc. It is possible that my intellectual decadence accounts for my failure to grasp the alchemy by which, through some magic mathematical formula, entrepreneurship, capital, fuels, etc. etc. can be equated; or it is possible that I'm just medieval, refusing to budge from my basic position that **Labour Productivity is nothing but Total Productivity.**

We shall, however, not stay at this historically futile point, but move on to reconsider Labour again, under the Problem of Change. We calculate labour in manhours: but whereas in Western countries, women are entering industry on a large scale--that is also what is going to happen in this country—we have to consider whether a womanhour of labour is the same as a manhour of labour: It surely is not; and to solve the difficulty by taking them as equal or womanhour being 3/4 or 1/2 manhour, may be an inevitable compromise, but has little justification in fact.

The difficulty, however, is more fundamental, for **a manhour of 1967 is not a manhour of 1961, much less of 1969,** for the economic and social changes of the last two decades have transformed the very quality of Labour: the skills, the attitudes, the educational background have undergone a sea-change. This makes a vast philosophical hole in the very nature of our statistics, and makes me revert to my old humdrum thesis that it is the quality of judgment of the econometrician rather than his mathematics that is more important in this Problem of Measurement.

Concerning Labour Productivity, there is another matter of very vital importance: the nature and the magnitude of capital equipment, with which Labour is associated, for this could make all the difference in the world. A bullock cart driver, a railway train driver, a pilot, an astronaut are all drivers, but the equipment with which they deal, determines the nature and speed of their work, also their skills and attitudes.

It is therefore that, of late, there has been a switch over from Labour to Capital Productivity. In fact, in the Measurement of Productivity, particularly in India in recent years, when we have been injecting massive doses of capital into the economy, there is a presumption, supported by substantial statistical evidence, that while ostensibly Labour Productivity has fairly well gone up, the increase in Capital Productivity has been negligible, or even negative in certain areas. In my paper on Measurement to which I made a reference earlier, we calculated that while the over-all Labour Productivity,

taking organised industry as a whole, had gone up by 38 percent during 1951-60, Capital Productivity had risen by only 11 per cent! In subsequent calculations, in fact, we were faced with a dilemma, for we found that while Capital in Indian Industry had gone up by over 2000 per cent between 1951 and 1968, nobody could credibly argue that productivity could have gone up even fractionally, compared to the increase in investment!

A point of interest, which I may just mention here (for there is no space to elaborate it) is that in socialist countries, the real crux of their planning is Capital Productivity, though it is worked out in terms of Labour Productivity, which as we know is only a difference between Tweedledum and Tweedledee. As ours is also a socialist country—I presume it is, at least by a solemn resolution of Parliament—it is a point for consideration, whether we should not switch over to Capital Productivity; and I may be permitted to say in lighter vein that while the Capitalist has reason to know what he is getting out of his Labour, the Socialist would be well advised to ascertain what he's getting out of his Capital. **'Exploitation' of capital rather than of labour may be the solution to our most intractable problems.**

In the same light, we may consider Materials Productivity, called by a number of names in the Materials Management literature. If we analyse the cost of production of any commodity, materials account for 50 to 80 per cent of the total cost of production, and Labour as low as about 10 per cent. That is why, it has been argued rather forcibly that in this country we ought not to be worried so much about Labour Productivity. But an economy in materials is likely to give us sizable gains. In fact, **the critical factor in Economic Growth will be found to be the shortage of materials, certainly not of men, in such overcrowded areas, as ours.** Take, for example, our natural desire to raise per capita cloth consumption to say 100 yards; but it means so many times more cotton; and where do we get it? —by diverting area from foodgrains, sugarcane, oil seeds?

We may end this Paper with a quotation from Keynes, regarding the legitimate (or rather, illegitimate) use of mathematics, for among statisticians, there is a natural temptation to resort to befuddling mathematical formulae, tautologies, when simple explanations could suffice for a clear understanding of what is happening.

In his *General Theory of Employment, Interest and Money*, Lord Kenyes used mathematics to the extent necessary. In the course of the argument, however, the author had occasion to examine the 'recent' mathematical advances in economic science; and at places, he could not hold his heart and went at the economists, who used mathematical techniques, whether essential to the argument or not, without making clear that in the dynamics of economics, the use of mathematical formulae involves assumptions and limitations, which are seldom clear to the persons to whom the arguments are addressed. Keynes referred bitterly to "the pitfalls of a pseudo-mathematical method, which can make no progress except by making everything a function of a single variable and assuming that all the partial differentials vanish..."

Later, discussing the Theory of Prices, he expressed himself at length on the relative merits of the mathematical formulation and the commonsense argument: "It is a great fault of symbolic pseudo-mathematical methods of formalising a system of economic analysis...that they expressly assume their strict independence between the factors involved and lose all their cogency and authority if this hypothesis is disallowed: whereas in ordinary discourse, where we are not blindly manipulating but know all the time what we are doing and what the words mean, we can keep "at the back of our heads" the necessary reserves and qualifications and the adjustments which we shall have to make later on, in a way in which we cannot keep complicated partial differentials 'at the back' of several pages of algebra which assume that they all vanish. Too large a proportion of recent 'mathematical' economics are mere concoctions, as imprecise as the initial assumptions they rest on, which allow the author to lose sight of the complexities and interdependencies of the real world in a maze of pretentious and unhelpful symbols...."

APPENDIX

Production and Productivity

During the last decade when Productivity has come up as a subject of considerable interest, there has been in many circles a good deal of confusion as between Production and Productivity. In fact this confusion has persisted even among the governing, intellectual and business classes to the extent that is really incredible. It is, therefore, necessary to define and clarify the two concepts, and differentiate them so that there may be no cause for confusion.

Production of any commodity or service, either individually or sectorally, is the volume of output, irrespective of the quantity or quality of resources deployed to achieve that level of output. As such, production is obviously a rather primitive or gross factor. Once we put into it an element of efficiency with which the resources are deployed or with which certain self-employing resources deploy themselves, we enter the area of productivity.

Obviously there can be no production without some measure of productivity, for there must be some organization, which causes the output to materialise; there must be some efficiency with which the job is completed: but the level of this productivity makes all the difference in the world to the persons and the communities concerned. The countries that are rich and advanced are the very countries which have made massive advances in productivity. There is no other explanation for the high standard of living that the people of the United States enjoy, alongside an almost incredible capacity to feed the hungry world in essential commodities in which it is deficient. *Per Contra*, the explanation of our country's poverty is the low level of productivity in practically every sector of the economy, as characterising practically every factor of production, from management to the workers, Government including. **Everything in this country works slowly, men's minds most of all,** particularly where it concerns the achievement of certain desirable ends.

If we realise this factor of productivity, several things fall into their proper places, such as the very high wages in the United States and the very low wages in this country. The minimum wage in the United States as established by law is 2 dollars an hour. This has to be paid to the sweeper, dish washer and anybody else who is asked to work. This works out to Rs. 120 per day for an 8-hour day. There are very few people in this country who by their labour even in the higher echelons of the civil service make that much per day.

Nevertheless the American economy is highly competitive, and our economy, more or less, is totally uncompetitive. The obvious explanation is productivity. Despite very high wages, their unit cost works out to a very low figure; and in spite of our very low wages our unit costs are high. In fact, if the import controls were removed, our economy would be swamped by foreign goods on all accounts, including all manner of necessities and luxuries. Our industries are surviving in spite of their low productivity behind the rigid protective wall of exchange control.

Of course, there are many factors that enter into the determination of the level of productivity the primary one being the quality of the people as determined by several historical forces, including the pressures of the current environment. The quality of Government, above all, the quality of local administration are factors that affect the productivity of the concerns within their jurisdiction. A corrupt and inefficient administration is naturally reflected into the productivity of the economic system.

These, however, are taken as given factors. Immediately determining the productivity of a concern is the quality of management at the micro-level; for it is the management whose ideas and practices and procedures determine the behaviour of all the individuals assocated with the concern. *There can be no high productivity without high quality management.* It is the management which brings the resources together. It is the management which schedules their deployment both over a long as also over a short period. It is the management which motivates the workers. It is the management which brings

in the latest techniques and puts in it heart and soul to see that the techniques get into the actual operation.

In Productivity, special mention is to be made about what is called front line management, the supervisors, the foremen, the chargehands, the *mukkadams*, for they constitute the main line of communication between the upper layers of management and the general body of operatives. Their level of education, their culture, their attitude to life and affairs, their technical ability, are vital factors in determining the productivity of a concern.

The last but not the least are the actual operatives on the shop floor. They hold the key to the system as it works. Maybe, it is a "switch on" or "switch off" affair, but they are there; and they have to be motivated to do the jobs that keep the shop running. Uneducated and disgruntled workers can bring down the productivity of a concern to a pretty low level. It is, therefore, vitally important for purposes of productivity that the management should make an investment in their education, their training, operational, as well as in human relations, etc. etc. The management must, above all, pay them a fair day's wage. The anomaly of the present system is that a fair day's work is expected before a fair day's wage is paid. On the other hand the workers expect a fair wage to be paid before they will do a fair day's work. Between the two, the country is ruined; and we get a very low level of productivity. The Government must, therefore, evolve an equitable formula about sharing the gains of productivity. In fact there is sufficient provision for it in the Directive Principles of State Policy.

Often in historical discussions, considerable importance has been given to the transforming nature of modern techniques, mechanisation, rationalisation, computerisation, in achieving higher and higher levels of productivity. While there is no doubt about this basic position, Human Engineering has often been forgotten. This may well hold the Key to Productivity.●●●

The Productivity of Youth

'Edmund Leach, who recently delivered the controversial Reith Lectures on the B.B.C., explained why old people are honoured in human society. 'Among the Australian aborigines, for example', he stated, 'many crucial pieces of information about the environment—such as the location of waterholes, weather lore, and the habits of animals and plants—are treated as an esoteric form of knowledge known only to a small circle of very old men whose secrets are passed on bit by bit to the younger members of the tribe in a course of long series of initiations'. 'But', argued Dr. Leach, 'in societies like our own, which are undergoing rapid development, it is the young adults, not the old ones, who possess the kind of knowledge which young people need to share before they can participate fully. With us, for example, it is by and large the men under 40 who know what is worth knowing—the computer men, the microbiologists, the ethologists, the radio astronomers: in such fields anyone with white hair is already hopelessly out of date.'

—*Seminar*, June 1969

Productivity in Retailing

KK Taimni*

The vital role played by the retailer as the final link with the consumer in the process of distribution, especially in the present context, has not been adequately appreciated in India either by marketing experts or by producers of consumer products. For too long and too often have misconceptions surrounded the functions of retailing: it is still frequently described as 'unproductive' as a superfluous and costly intermediary between the manufacturer and the consumer, and as an effective hindrance to lower prices and higher living standards rendered feasible by mass production techniques and new materials.

THE CONCEPT OF SERVICE IS A SLIPPERY ONE; yet retailing may be called a service industry in as much as it creates 'place and time utility' instead of 'form utility' created by the manufacturer.[1] Though modern economic organisation is grounded upon the principle of division of labour, it is only recently that retailing has become a specialised activity, separated from production.[2]

Retailing is really a part of a continuous process going on between factory and household in which goods are changed in form, packed, transported and sub-divided (It is this last aspect that is etymologically the true retailing function, since the word is related to 'tailor' or 'cutter').[3]

The role and the function of the retailer in a modern economy is worth analysing for several reasons, though it is not an easy task to attempt a valid definition. Perhaps the two most important functions of the retailer are the provision of immediate availability of goods and the supply of information to the consumer through personnal inspection, in advance of purchase. To perform this role, the retailer holds the stocks in anticipation of actual demand, and takes risk. It is this latter part which, the economists think, adds to the value of the merchandise and entitles the retailer to charge a margin from the consumer. The value added to merchandise at the various stages of distribution and the facilities thereby offered to customers, vary in accordance with the needs of the consumer.

The importance of retailing in the process of satisfaction of the needs and requirements of the consumer is indeed crucial. Retailing, the final stage of distribution, is by far the most important, whether measured by function, by numbers employed, by the number of economic units engaged or by the proportion that retailing represents of the total distribution costs.[4]

From this premise, it is apparent that improvements in productivity by the retail sector are of significance. Productivity Team reports on the European distributive trades indicate not only that retailing is the most significant sector of distribution but also that a deep study would be more rewarding in this field.

In no country can retailing be compared in efficiency with manufacturing industry; and this is true both for developed as well as developing countries.[5] In India, in particular, retailing continues to be rather too labour intensive as compared to manufacturing industry which, more or less, is capital intensive in varying degrees. Productivity in retailing lags behind that in Industry, and absorbs a growing percentage of labour resources. The absence of any reliable

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1. W.G. McClelland 'Costs and Competition in Retailing' Macmillan, 1966, pp 230
2. Ibid pp 2
3. Ibid pp 2
4. Jefferys, Husberger and Lindbled, "Productivity in the Distributive Trade in Europe" O.E.E.O. Paris, 1954, pp 55
5. Christina Fulop 'Competition for Consumers' I.E.A. London, Andre Deutsch, 1964, pp 5

data on the subject makes it impossible for one to calculate, how long, historically, it has been the case. However, estimates for the USA over half a century indicate, as shown in Table I, the failure of distribution to keep pace with the increase in productivity in production.

TABLE I

Output per man in Commodity Production and Distribution in the United States 1899-1949

(Index 1899=100)

	Pre-Depression	Pre-War II	Post-War
Commodity Industries	224	236	338
Distribution	125	106	120
Production & Distribution combined	207	206	278

Source: H. Barger, Distribution's Place in the American Economy since *1869*, 1955[6]

It is true that this is a very crude way of the measurement of productivity in retailing as it is in the form of employment of man-power in retailing. This is particularly vulnerable especially in India where the Consumer finds himself in a Sellers' Market, where the retailer can almost dictate his terms. In war-time England, retailers raised their productivity by operating through few employees dealing with limited supplies of merchandise. These special factors enabled sales per head or per square foot to be maximised and raised the efficiency of retailing at the expense of the consumer, who was compelled to queue, to shop around for limited supplies, to find her choice of merchandise curtailed and to carry purchases home with her. Hence, real productivity which may be defined as the 'output', value added for the consumer, divided by the 'input' of the factors of production was effectively reduced. The present study accordingly excludes all those commodities, which are either controlled or scarce in supply in order to bring out unbiased results.

Factors Influencing Productivity

In retailing, a business has a geographically limited market, the scale of operations depending on the size or density of the local market. A positive correlation might be expected between productivity and the size of town on the grounds that larger towns are able to support larger shops which can make fuller use of economies of scale.[7] It will be interesting to add here that the mere size of town in terms of its population will not have any material effect on productivity, for purchasing power is a vital factor, since we are here concerned with aggregate retail sales. Productivity in retailing is really a "function" of the per capita income of a particular town. There is a much better correlation, however, between sales per inhabitant and the ratio of radio or car licences to households[8] or even with the rates of hair cut.[9]

Statistical studies in some European countries have established that labour productivity in retailing can also be correlated with tightness in the labour market. Some of the important factors, which influence productivity are: the degree of Industrialisation and Urbanisation, incidence of unemployment, educational background of consumers, their ages, social and economic backgrounds, and competition.

Some experts think that productivity in retailing depends, to a considerable degree, on the location of the shop. It tends to increase, as one approaches the central shopping area of the town. Productivity is also influenced by the type of ownership of the retail outlet. Self employed retailers tend to have higher productivity than, say, cooperatives or other shops which have 'absentee ownership' and employ full or part-time workers. No positive relationship, however, has so far been established between 'retail' productivity and the sex of the employees.†

Measurement of Productivity

It is one thing to talk of efficiency in the distributive trades, but it is quite another to

6. Quoted from 'Competition for Consumers, op cit, p. 7

7. K.D. George: 'Productivity in Distribution' Cambridge University Press 'Occasional Papers', 1966, pp 19

8. K.D. George: op. cit, pp 29

9. Fourastie in "Productivity, Prices and Wages" quoted from the paper 'Influence of the Standard of Living on the Development of Retail Trade' by G. Lindblad, presented to "Intercoop 67 Non-Food Conference" held in Berne from May 9 to 12, 1967

† Very strange, for how else does one explain the considerable switch over that has taken place in the post-war period to the employment of sales girls?—Editor,

create the necessary instruments to measure it. Input can certainly be calculated in quantitative terms, but output is not necessarily the sum total of goods sold, despatched and paid for. Service to the customer cannot be easily and directly measured. No discussion of increased productivity, therefore, can take place without some definition of terms and limitation of scope. Two suggestions have been made for the measurement of productivity: either the provision of the same output (that is the same group of goods and services) to the Consumer with a smaller input (that is a lower unit cost as measured by the outlay of the factors of production, of labour, space, capital etc.), or, the provision of an increased output (an increased amount of goods or a greater volume of service or both) with the same input (the same unit cost as measured by the outlay of the factors of production).[10]

The common techniques employed to measure productivity in retailing are to find out:

i. Sales per man per day,

ii. Sales per square foot, and

iii. rate of stock sales

The results of a recent study by this writer about the productivity in three different types of shops in two towns of Punjab where these techniques for measurement were used are given in Tables II & III.[11]

TABLE II

Productivity of Labour and Space

(April '68—June '68) adjusted

Dry Groceries

Average Income of the household	Average Sales per man per day	Average Sales per sq. ft. per day
Rs 300-500	Rs 288	Rs 3.65
Rs 500-800	Rs 347	Rs 4.15
Rs 800-above	Rs 412	Rs 4.95
Toilet and Cosmetics		
Rs 300-500	Rs 219	Rs 2.68
Rs 500-800	Rs 263	Rs 3.12
Rs 800-above	Rs 365	Rs 4.10
Cloth (Cotton and Terylene only)		
Rs 300-500	Rs 191	Rs 2.15
Rs 500-800	Rs 227	Rs 2.68
Rs 800-above	Rs 310	Rs 3.08

Notes: (1) All figures have been standardised by keeping the investment in stocks (selling rates) at Rs 10,000

(2) The proportion of selling areas to non-selling areas has also been standardised in the following ratios:

Dry groceries	70 : 30
Toilet & Cosmetics	60 : 40
Cloth	60 : 40

(3) Figures relate both to private and cooperative shops

(4) In order to calculate fair averages, assortment in different groups has been rationalised and commodities which had sales-stock turnover ratios of less than 4, 3.5 and 3 respectively in the three groups, have been omitted

(5) The selection of the shops was made according to the average income of the household and only those shops were selected where more than 75% of the customers belonged to the given income bracket.

The above Tables give the productivity of labour and space in shops. The following Table gives the productivity of stock in the shops.

TABLE III

Stock-Sales Turnover Ratios (Annually Unadjusted)

(April '68 to June '68)

Income of the Household	Groceries	Toilet & Cosmetics	Cloth
Rs. 300-500	7.42	5.81	4.21
Rs. 500-800	8.23	6.40	4.62
Rs. 800-above	8.61	7.35	4.45

In all the three measurements the above figures for sales have been taken as the final output and, consequently, these provide the base to measure the Productivity. This is too simple an arrangement but has been found to be useful under very special circumstances only. The following points would make it clear.

i. The above measurement takes only sales figures into consideration and omits service altogether. It might as well happen that one particular shop-keeper might increase his productivity at the expense of the consumers' convenience. It does not quantify the quality of service into output. It ignores the break-up of the commodities within the shop and this can be a major factor in influencing the volume of sales.

10. Stacey & Wilson 'The Changing Pattern of Distribution', Business Publications Ltd., London pp 166

11. The selection of these types of shops was done, keeping in view the pattern of distributive trade in the country. See article 'Distributive Trade Pattern in India' in "The Economic Times", March 14, 1968

It also does not take into consideration the relationship between the margin of profit and the labour cost in selling a particular commodity/ commodities.

ii. Independent researches in England reveal that labour productivity is a function of labour market conditions, size of shop, the market share of multiples and cooperatives, and income per head, and suggest that all the four explanatory variables are significant in 'explaining' overall productivity differences, the overall degree of explanation being over 80 per cent.[12]

iii. Except between countries and through time, there are no indices of relative prices, and the difference in price level may be significant for comparisons between types of organisation or sizes of establishment.

iv. There is also the fact that the composition of sales may differ in such a way that articles involving the retailer in greater or less than average cost in proportion to their value, take a higher or lower share of the total sales.

In spite of these handicaps, the three ratios do give a fair idea of efficiency in retail outlets if suitable indices of price levels are worked out for different towns and different groups of commodities. Deflation of these figures with the help of these indices would give an idea of relative productivity attained in different shops, for a given period.

To overcome the elements of variation inherent in sales value, it has been suggested that quantitative measures of retail output, independent of value, are vital if comparisons of productivity in retailing are ever to be usefully made, and that the number of transactions is the most useful one to begin with.[13]

The underlying principle of this somewhat sophisticated approach is that in retailing, as distinct from manufacture, most of the work cannot proceed at a factory pace, determined by the capacity of the workers and plant, but goes on by fits and starts, dependent on the pleasure of the customers. Customers come in between 11 and 12 noon, or on Saturdays, or when buses arrive or at just random intervals. When they arrive, work proceeds more or less energetically and when they have gone, it proceeds less energetically or stops. The load factor is important in retailing as in passenger transport or electricity generation.

Here, the whole question of retail productivity or efficiency and the wages cost of retailing, are discussed in the form of different ratios, according to the focus of interest, the data available and the particular circumstances of comparison.

If we write

S = Sales
T = Transaction
Mw = Manhour worked
W = Wage Bill

then $\frac{S}{Mw} = \frac{S}{T} \times \frac{T}{Mw}$ ..... (1)

i.e., Sales per manhour = Value of average transaction × transaction per manhour.

Also $\frac{W}{S} = \frac{W}{Mw} \div \frac{S}{Mw}$ ..... (2)

i.e. Proportion of Wage bill to Sales = Average wage ratio ÷ Sales per manhour.

Equation (2) shows that if as a result of paying higher rates of wages, sales per person per hour increase more than in proportion, the wage percentage to sales will decline.

Further, if

A = number of articles sold

then S/A = Average price per article

and A/T = Articles sold per customer

so that $S/T = \frac{S}{A} \times \frac{A}{T}$

Substituting in (1) we get

$\frac{S}{Mw} = \frac{S}{A} \times \frac{A}{T} \times \frac{T}{Mw}$ ..... (3)

This analysis of average transactions value into two components is of little relevance in the shopping goods trade, but it is of most relevance in the grocery trade, in which most customers buy several articles.

Now, if Ms = Manhours spent serving customers, we will then have $\frac{S}{Ms}$ $\frac{A}{Ms}$ or $\frac{T}{Ms}$ as

12. 'Productivity in Distribution' op. cit, pp 81

13. 'Costs and Competition in Retailing', op. cit. pp 79. The subsequent discussions and the formulation of different ratios are based on the Chapter 'Productivity' of the book.

measure of what might be called 'Productivity at the counter'.

$\frac{Ms}{Mw}$ = the proportion of time spent serving to total time worked

$\frac{Ms}{Mw}$ will be also the co-efficient of utilisation of labour.

$$\text{Noting } \frac{T}{Mw} = \frac{T}{Ms} \times \frac{Ms}{Mw} \quad \ldots\ldots\ldots (4)$$

we can expand equation (3) into the following form:

$$\frac{S}{Mw} = \frac{S}{A} \times \frac{A}{T} \times \frac{T}{Ms} \times \frac{Ms}{Mw} \quad \ldots\ldots\ldots\ldots (5)$$

The process of serving, where several articles are bought at a time in a grocery shop, consists partly of assembling the articles required one by one and partly of greeting the customer, taking payment and giving change. If the data were available it would be useful to express time required as (aT bA) (A being the aggregate number of articles, T the number of customers and a and b constants)

Substituting for Ms in equation (5), we have

$$\frac{S}{Mw} = \frac{S/A \times Ms/Mw}{a + b/A/T} \quad \ldots\ldots\ldots\ldots (6)$$

∴ Sales per manhour, which is a measure of the productivity of labour would be given by equation (6) above.

This measure is considered to be more exact than the ordinary method of sales divided by number of effective mandays, in that the price level taken into consideration here through S/A is not the price per Kg. or price per metre, but the 'price per article sold as a separate article' which may be very different. Differences in the composition of sales within the same trade, all articles being handled in the same way, also affect sales per person through this factor. So do differences between middle class and working class localities and in the importance of any semi-wholesale transactions. This method has been widely applied by large retailers to find out the requirements of labour to attain a given sales volume in given circumstances. This technique also helps in deciding the employment of part-time workers, if circumstances so warrant, in order to raise productivity of labour.

Ways of Increasing Productivity in Retailing

Many attempts in different directions have been made of late all over the world to seek new ways of increasing the productivity in distribution. A few are given below.

Automation: The introduction of mechanisation in place of manual labour, like replacement of cashier with cash register, book keeper by accounting machines etc. have resulted in increasing the productivity of shops in most of the Western countries.

ii. *Work Study*: Work study techniques have been adapted to the special conditions of retailing and as a result of invstigation of customer flow, departments have been re-sited, fixtures, counter and cash registers rearranged to minimise the time and effort of sales assistants, and units of stock holding and display have been redesigned.

iii. *Functional Integration*: Intergration of functions at a single stage like prepacking, advertisement, sales campaigns either by the manufacturers or jointly by many retailers has also resulted in increasing the productivity of the retailer.

iv. *Consumer Facilities & Incentives*: Introduction of new techniques like self-service, self selection have helped many retailers to increase their productivity. Similarly, in order to spread the consumer demand uniformly over a week and control the consumer buying habits, certain ingenious means have been adopted. For instance 'to encourage mid-week shopping, a cooperative shop in England introduced recently 'investment tokens'. Purchased on Thursday, Friday or Saturday for 2S 6d, they were worth 2S 9d to theshopper, who spent them on Monday, Tuesday or Wednesday,[14] or the recent experiment of the 'free day' run by the Migros organisations in Switzerland. A cash refund was offered to the customers who had

14. 'Self Service', August 1962, quoted from 'Competition for Consumers' op. cit. pp. 11

sales receipt dated the day of the month with the lowest sales.[15]

Probably the quickest increase in productivity can be brought about at the lowest cost, if retail organisation is adapted to the shopping characteristics of the cosumer, rather than expecting the consumer to conform with out-of-date shopping hours, staff employment which does not coincide with customer flow, and selling methods which do not accord with customer requirements.

A beginning has to be made in this country, for the current stress on industrialisation is likely to result in increased standards of living of our people and the existing distributive trade will then come under extra strain to meet the demand of the new affluent consumers.●●●

15. Reported in M.P. McNair, W. Applebaum & WJ Salmon, Cases in Food Distribution (1964) pp. 403-26

" Hope you don't mind, Boss, The boys have a little bet on !"

State-wise Study of Relative Efficiency in Industry

J D Kale*

'Value added', attributable to a fixed amount of input, is a good measure for judging the performance of a particular industry. This measure has been used, in this article, to compare the relative efficiency of certain industries in four industrially advanced States of the Indian Union: Gujarat, Madras, Maharashtra and West Bengal. The industries selected are (i) Miscellaneous food preparations (ii) Spinning, weaving and finishing of textiles (iii) Textiles not elsewhere classified (iv) Basic industrial chemicals including fertilisers (v) Machinery and equipment (except electrical) and (vi) Electric Power. Value added, due to all industries, has also been analysed. The period covered is 1961 to 1965, more or less co-extensive with the Third Five Year Plan.

The statistical technique of analysis of variance has been applied in testing variations in value added in different States and over the years.

VALUE ADDED BY MANUFACTURE REPRESENTS that part of the value of the product which is created in the factory and is computed by deducting from the gross ex-factory value of output, the gross value of input comprising cost of materials, fuels, etc; amount paid for work done by other concerns, industrial services purchased, depreciation and the purchase value of goods sold in the same condition as purchased. Value by manufacture for every one hundred rupees worth of gross input has been computed in the case of every industry under reference in each State for every year. It is assumed that in any particular industry, irrespective of its location in any State, input factors are more or less similar. Value added is therefore a yardstick to measure relative efficiency of that industry.

The results of the analysis are presented in the Tables printed below :

Table 1

Average Value Added

(Rs. per Rs. 100 of input)

Industry	State			
	Gujarat	Madras	Maharashtra	West Bengal
Miscellaneous food preparations	17	25	7	15
Spinning, weaving and finishing of textiles	45	44	48	35
Textiles not elsewhere specified	19	14	23	40
Basic industrial chemical including fertilizers	50	43	45	45
Machinery and equipment except electrical machinery	49	57	49	61
Electric light and power generation.	47	54	52	56
All industries.	39	39	41	37

*Research Officer, Bureau of Economics & Statistics, Government of Gujarat, Ahmedabad.

Table 2

Average Value Added

(Rs. per Rs. 100 of input)

Industry	Year 1961	1962	1963	1964	1965
Miscellaneous food preparations	16	18	15	15	16
Spinning, weaving and finishing of textiles	45	45	47	40	38
Textiles not elsewhere specified	39	38	25	18	20
Basic industrial chemicals including fertilizers	44	46	45	42	51
Machinery and equipment except electrical machinery	57	54	52	54	51
Electric light and power generation	47	46	42	65	61
All industries	40	41	39	38	37

Table 3

Value Added

miscellaneous food preparations

(Rs. per Rs. 100 of input)

State	Year 1961	1962	1963	1964	1965
Gujarat	17	16	17	17	17
Madras	23	28	27	22	17
Maharashtra	9	8	5	7	7
West Bengal	14	19	11	16	13

Table 4

Value Added
spinning, weaving and finishing of textiles

(Rs. per Rs. 100 of input)

State	Year				
	1961	1962	1963	1964	1965
Gujarat	54	44	43	42	42
Madras	47	43	55	39	34
Maharashtra	53	52	48	45	44
West Bengal	27	41	41	36	31

Table 5

Value Added
textiles not elsewhere specified

(Rs. per Rs. 100 of input)

State	Year				
	1961	1962	1963	1964	1965
Gujarat	17	22	21	13	22
Madras	11	17	14	12	15
Maharashtra	27	26	22	19	19
West Bengal	60	47	43	28	23

Table 6

Value Added
basic industrial chemicals including fertilizers

(Rs. per Rs. 100 of input)

State	Year				
	1961	1962	1963	1964	1965
Gujarat	59	41	55	46	51
Madras	30	37	40	41	66
Maharashtra	43	53	42	43	43
West Bengal	43	55	43	39	44

Table 7

Value Added
machinery and equipment except electrical machinery

(Rs. per Rs. 100 of input)

State	Year				
	1961	1962	1963	1964	1965
Gujarat	56	52	47	44	44
Madras	57	54	63	51	59
Maharashtra	50	50	46	50	50
West Bengal	67	62	53	72	53

Table 8

Value Added
electrical light and power generation

(Rs. per Rs. 100 of input)

State	Year				
	1961	1962	1963	1964	1965
Gujarat	55	52	36	39	51
Madras	54	48	14	86	70
Maharashtra	31	44	54	70	62
West Bengal	47	42	66	67	60

Table 9

Value Added
All Industries

(Rs. per Rs. 100 of input)

State	Year				
	1961	1962	1963	1964	1965
Gujarat	45	38	39	35	38
Madras	40	39	38	39	38
Maharashtra	42	45	41	40	38
West Bengal	33	42	47	38	36

Table 10

Analysis of Variance

Miscellaneous food preparations

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	Variance ratio F
Between States	3	842.00	280.67	57.51**
Between years	4	17.50	4.38	0.90
Error	12	58.50	4.88	
Total	19	918.00		

Table 11

Analysis of Variance

Spinning, weaving and finishing of textiles

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	Variance ratio F
Between States	3	471.75	157.25	5.40*
Between years	4	227.70	56.93	1.95
Error	12	349.50	29.13	
Total	19	1048.95		

*Value of F (variance ratio) at 3, 12 = 3.49 at 5% level of significance.
= 5.95 at 1% level of significance.
**Value of F (variance ratio) at 4, 12 = 3.26 at 5% level of significance.
= 5.41 at 1% level of significance.

Table 12

Analysis of variance

Textiles not elsewhere specified

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	Variance ratio F
Between States	3	1967.00	655.67	11.95**
Between years	4	374.30	93.58	1.71
Error	12	658.50	58.88	
Total	19	2999.80		

Table 13

Analysis of variance

Basic industrial chemicals including fertilizers

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	Variance ratio F
Between States	3	160.60	53.53	0.64
Between years	4	179.70	44.93	0.54
Error	12	999.90	83.33	
Total	19	1340.20		

Table 14

Analysis of variance

Machinery and equipment except electrical machinery

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	Variance ratio F
Between States	3	574.00	191.33	5.65**
Between years	4	87.50	21.88	0.65
Error	12	406.50	33.88	
Total	19	1068.00		

Table 15

Analysis of variance

Electric light and power generation

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	Variance ratio F
Between States	3	268.40	89.47	0.35
Between years	4	1624.30	406.08	1.61
Error	12	3026.10	252.18	
Total	19	4918.80		

Table 16

Analysis of variance

All Industries

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	Variance ratio F
Between States	3	40.55	13.52	1.74
Between years	4	33.20	8.30	1.04
Error	12	93.20	7.77	
Total	19	166.95		

"And the voice of the man who wishes Government to do less for less is still heard."
—JK Galbraith

RELIABILITY

P Gopalakrishnan*

Reliability is one of the latest management concepts that is being increasingly applied in India to get increased industrial productivity. However, the task of designing and supervising the manufacture of a product is itself getting exceedingly complex due to various factors : cost, size, weight, ease of manufacture, maintenance, etc. For instance, the maintenance of many electronic equipments often exceeds the original cost of procurement even during the first year of its operation. Problems of performance, particularly in the design and development of highly complex equipments as in missiles and space flights, which have to function under conditions of great stress, have come up with Reliability as almost the ultimate in the criteria for acceptance. Many years back, the advisory group on reliability of electronic equipment (AGREE) in the USA prepared a report on reliability of military electronic equipments : this report formed the basis of further reliability studies. In recent years the reliability concept is being increasingly utilised in commercial manufacturing operations like automobile, radio, television and such other equipments in order to avoid frequent and unpleasant inconvenience causing customer dissatisfaction, loss of business, etc. resulting from unreliability.

PRODUCT RELIABILITY IS DEFINED AS THE probability (or proportion of times) that the product will function adequately within specified limits for at least a specified period of time under operating conditions, without failure. The operating conditions include environmental conditions, humidity, shock, pressure, vibration, temperature, etc. The objective of reliability studies is to give an assurance of maximum time stability of the product's specified performance.

The most important method of achieving a reliable product is through a natural design by exhaustive testing in order to obtain the required degree of reliability within the limits of the imposed restriction.

Maintainability is also a factor in effective reliability. If parts are available, interchangeable, and replaceable, failures may be repaired quickly by replacing defective parts and components. It should also be ensured that the replacement should be expeditious, without requiring the disassembly of adjacent units.

Another method of achieving reliability is 'debugging' or 'burn in' at the infant stage. It is a method of accelerating the completion at the infant stage by operating the unit day and night until all early failures are isolated and eliminated.

A system's overall reliability can be predicted by synthesising the reliability of the various individual items constituting the system. With this, the designer can spot out the parts which adversely affect overall reliability and therefore can resort to "redundancy" wherein more than one element is employed to assure better reliability (e.g. four engines in an aircraft, multi-cylinders in a car, more bulbs in a room for illumination, etc.). This implies that the more alternate components there are, the greater the probability that one of them (and hence the total system) will operate successfully.

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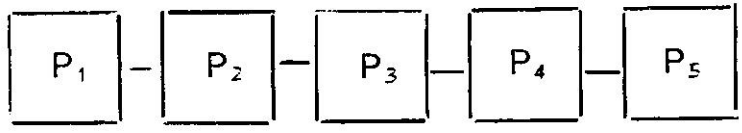
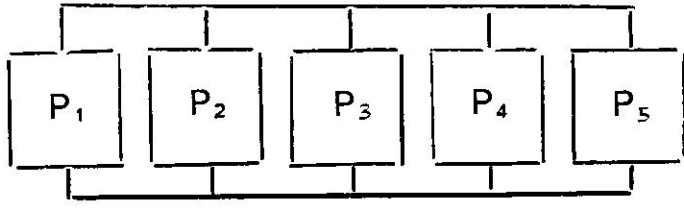
It is also possible to improve reliability by means of a switchover wherein if the primary unit fails a standby unit is substituted on to take its place (as in telephone, standby transformers, etc.). In this context, it will be advantageous to examine the series and parallel systems.

A series system is one in which all components are so interrelated that the entire system will fail if any of its components fails, whereas a parallel system is one that will fail only if all the components fail. For instance let us now consider a system of five components (P_1 to P_5) connected in series as follows :



Let us suppose that the components are independent, that is, the performance of any one part does not affect the reliability of the others. Assuming that the reliability of each is 0.97, the reliability of the entire system is $(.97)^5=0.86$.

One way to increase the reliability of the system is to replace certain components by similar components connected in parallel. (see diagram below)



For a parallel system, the product law of unreliability is similar to the product law of reliability for a series system: $(1—.97)^5$ is the probability of unreliability; or reliability of the parallel system $=1—(1—.97)^5$ or nearly 1. It is also possible to use both parallel and series system, in order to increase the reliability wherever possible.

A special method wherein early results are required in connection with very high reliability components, is that of accelerated life testing. Here, the components are put on test under environments that are far more severe than encountered in practice. This causes the components to fail more quickly and this can drastically reduce the time required for the test. Preliminary experiments are carried out to determine the relationship between the proportion of failures that can be expected under normal conditions and under various levels of accelerated testing. The conditions should be so laid down that such a duration of accelerated life test would be equated to the actual life test. Accelerated life test has the advantage of providing the information much quicker so that corrective action on the manufacturing line can be initiated before it is too late.

Measures of Reliability

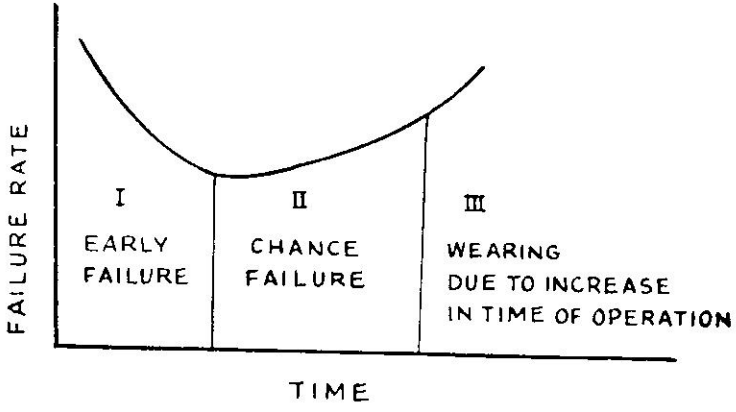
A measure of reliability should be accompanied by the prevailing physical or operating conditions. The measures of reliability usually adopted in practice are failure rate: probability of survival and mean time between failures, which are explained below:

The failure rate is commonly expressed as the number of failures per a fixed number of hours. The probability of survival is expressed as a decimal fraction or per cent which

indicates the number of parts that will function for a required time period. Mean time between failures (MTBF) is in fact the reciprocal of failure rate, and larger the value of MTBF, the greater is the reliability.

Failure Time Distribution

The reliability of a system will often depend on the length of time it has been in service and hence the distribution of the time to failure of a component is important. A failure rate curve typical of most manufactured items is given below: (This is called the bath-tub curve)



The first part is characterised by a decreasing failure rate: it represents the period wherein poorly manufactured items are weeded out. The second part is often characterised by a nearly constant failure rate: here only chance failures occur. The third part is characterised by an increasing failure rate: it is the period during which components fail because they are worn out. The same general failure rate curve is typical of the human body where the first part represents infant mortality, and the third part depicts old age mortality.

It is often assumed that the failure rate is constant during the period of the useful life of a component. The distribution of failure times is an exponential distribution when it can be assumed that the failure rate is constant. The function could be derived as :

$$f(t) = \alpha e^{-\alpha t}$$

Here $1/\alpha$ is referred to as mean time between failures for repairable parts (MTBF) and mean time to failures for the irrepairable (MTTF).

The time span of this normal operating life is referred to as the longevity of the products.

Weibull Model

Even though life testing of components during the period of useful life is generally based on exponential models, sometimes the failure rate of a component may not be constant throughout the period. In such cases the Weibull distribution describes the failure times of components when their failures increase or decrease with time.

The equation is

$$f(t) = \alpha\beta t^{\beta-1} e^{-\alpha t^{\beta}}$$

for $t>0$, $\alpha>0$, $\beta>0$

Conclusion

The application of these concepts would enable the designer to estimate the reliability of each item and also the overall system. Further the methods of improving the reliability can be applied with advantage to increase the reliability of the system.●●●

The Tipps Case

Kanwar Jit Singh*

Attitudinal training for executives often boils down to training programmes covering principles of management and human relations combined to give results in business terms. The claim is often made that accomplishment shall include both knowledge as well as skill in handling shopfloor problems in a more productive way. Dissemination of knowledge in certain areas and change of attitude are supposed to be geared to better supervisory practices. Such training programmes are initiated under various labels, giving rise to expectations in business organisations. Quite often disillusionment follows as soon as the programme nears completion. There are several stories which could be chosen to illustrate the excesses to which human relations practitioners are often prone. This is a typical case study in an Indian setting, designed to restore proper perspective in human relations training.

A REPUTED FIRM OF MANAGEMENT CONSULTANTS sent out a brochure to a hundred and odd large Indian companies, offering Supervisory training and development programme. For convenience we shall call the firm of management consultants by the name TIPPS.

We reproduce below the brochure *in toto* :

"A PROGRAMME FOR EFFECTIVE WORK-FORCE MANAGEMENT

WORK-FORCE MANAGEMENT ?

What is work-force management ? The phrase can produce different kinds of images. Some might visualise a scheme for squeezing out the last drop of work from the operator; some might see it as a disguised slave driver; some might see it as a programme for being 'nice' and 'soft'; some others might see it as yet another field-work assignment of some conscientious social-worker. To many it is an old story—a story heard several times over; a story that served its purpose in conferences, seminars and tea parties and was retired to its proper place with the last line of the vote of thanks. The moral of the story is impressive by its absence and is still elusive to those who seek it.

WHY NOT BEGIN WITH THE MORAL ?

Why Human Relations Training? Man and Machine are partners in Industry. They work together; they earn bread together. Despite popular notions of what automation can do, Man and Machine are inseparable. The efficiency of the one depends on that of the other. When either of them is below par, the other is also affected.

We have an elaborate service system for machines: oiling at 4 hours; bearing lubrication at 48 hours; stripping and cleaning at 16 hours; brushes changed at 6000 hours; overhaul at 10,000 hours; even purchase, installation, depreciation and replacement are part of a big service system for machines. The result is peak performance through their lives.

WHAT SERVICE SYSTEM DO WE HAVE FOR MAN ?

What do we do for maintenance and overhaul with Man? Or, are we satisfied with just Machine-service? If we are, then Human Relations Training has nothing to offer.

But if we think that it is RIGHT for Man to be entitled to a service system, and if we

* Personnel Officer, Jupiter Spg. Wvg. & Mfg. Co. Ltd., Ahmedabad. The case was collected by the author, when he visited certain engineering units in Bihar industrial towns.

recognize the fact that when the service-due Man runs a machine below par, the below par running itself may make Man further below par, perhaps starting a vicious circle, then we have found the moral of the story.

SUPERVISORY TRAINING

Ever since the second world war, TIPPS has been keenly interested in Supervisory Training. The form and content of the series of training programmes have undergone several modifications, to adjust to changing needs, through the years. Over the last year, TIPPS has been engaged in introspecting on the experience of the last 15 years. A great deal of stock-taking has led to a great deal of revision.

A PROGRAMME IS BORN

The result is the evolution of a Supervisory Training and Development Programme aimed, in the first instance, at the supervisor. (The Supervisor is that level of management which is directly in charge of and in contact with men and women working on production.) However, the level should only be a convenient gateway. For training to be successful, a changed outlook must be effected all along the hierarchical structure.

Related to the point above is the question of time. How long should it take for a change to occur in outlook? Two weeks? Two days? Two months? Such a "programme" does produce some change in a Supervisor; but it is not strong enough to make itself felt when the Supervisor returns to the total setting. The answer: Two years.

We can investigate the particular needs and problem-areas within a company.

We can tailor-make a training programme composed of two parts: established motivational methods and the particular needs and problem-areas of the organisation.

We can train ALL the Supervisors in the company over a period of nearly a year.

We can remain in active contact with the company over a year and a half.

As part of the programme, we can remain available all through the programme period for consultation at any level.

We can lay maximum emphasis on practice, so that as each subject is covered in theory it is followed by intensive practice-assignments.

A FULL TIME PROGRAMME

It may now be clear that training by itself is envisaged here merely as one part of a much wider activity. For training to be successful, it is essential that several other stages within the programme be also successful.

Just such a plan is involved in a Supervisory Training and Development Programme, with TIPPS staff engaged in full-time work over the entire period of two years.

Roughly, the programme may be thought of as comprising three stages:

In the first stage, much clearing of ground is done. Different organisations are required to make both different kinds and different degrees of change. At this stage, having selected a company, we get to assessing existing conditions in the company and planning a training course for its particular needs.

In the second stage, we commence our active training. Over a period of 51 weeks we train all the Supervisors in the company.

During the third stage of 30 weeks, perhaps the most important stage, the nature of our activity is to sustain the training function in everyday practice."

A company employing 3,000 workers and having a supervisory force of 70 subscribed to the programme.

The consultant started the project work with its first phase, wherein they wanted to in-

vestigate the *particular* needs and problem-areas within the client-mill and thereafter tailor-make a training programme. To achieve this aim, the following two surveys were conducted:

1. Supervisory Profile Survey
2. Supervisory Responsibilities Survey

In the Supervisory Profile Survey an analysis of supervisor's eight-hour day was made, highlighting the distribution of time on various activities and contacts. Supervisors were actually observed on work and a record was made of their activities after every five minutes during the work days. The result of the survey are tabulated here.

Percentage of time spent	Activity Code	Activity	Details of Activity
2.44	D	Discipline	Loitering, attendance, reprimand, notices...
11.58	A	Assignment	Instructions, orders...
12.83	P	Production	Requisitioning material, planning...
6.01	G	Grievances	Problem solving, listening to complaints...
23.13	S	Inspection	Patrolling, checking standards...
6.61	M	Maintenance	Care of machines, oiling, periodic overhauls...
15.79	R	Records	Reports, written communications...
00.81	H	House Keeping	Cleanliness, sweeping, fire extinguisher...
02.31	T	Training	Helping new hands, improving work methods...
17.80	B	Breaks	Recess, water, lavatory, cigarette...
00.70	O	Others	Remarks in space provided...

Time-wise interaction analysis during workday

Percentage of time spent	Code	Interaction with:
21.94	w	Worker
05.12	j	Jobber
05.71	s	Supervisor
00.17	u	Union Representative
03.97	d	Departmental Head
00.50	m	Higher Management
61.31	h	Himself
01.42	o	Others

The second survey pertained to Supervisory Responsibilities. Thirteen responsibilities were identified (along with definition):

1) MAINTENANCE—care of machines, equipment, servicing, periodic overhauls, ensuring stores supply....
2) GRIEVANCES—handling problems, complaints, union representations....
3) PRODUCTION PLANNING—applying company policy, machine allotment: ensuring materials supply....
4) DISCIPLINE—attendance, loitering, latecoming, labour laws....
5) ASSIGNMENTS—placement of workers, job instructions....
6) INSPECTION—rounds, maintaining schedules, quality....
7) RECORDS—reports, notices, written communication....
8) SELECTION—choosing new workers, appointments....
9) HOUSE-KEEPING cleanliness of department, neatness....
10) DEVELOPING WORKER—training, improving work methods, standards..
11) SAFETY—applying safety practices, accident prevention, first aid....
12) CO-OPERATIVE GROUP—building a team, pride in work, confidence of workers....
13) TECHNICAL MASTERY—uptodate knowledge; keeping pace with technological developments....

The Supervisory Responsibilities Survey was designed to discover what order of priorities (in terms of relative importance) is upheld at each level, i.e. Supervisory level, Departmental Head level and Managing Director level. The results of the survey showed that there were no two persons even within the same level who agreed as to the relative importance of various supervisory activities. Similarly at the other two levels also, drastically divergent opinions were upheld. On the basis of the above surveys, the following training contents were finalised:

	Topic	Unit
1.	Introduction and Appreciation	2
2.	Supervisory Responsibilities and Authorities	4
3.	Planning and Organisation	4
4.	Interpersonal Relations	$4\frac{1}{2}$
5.	Motivation	$3\frac{1}{2}$
6.	Discipline: Loitering, Absenteeism	6
7.	Job Instructions	10
8.	Group Discussion	10
9.	Grievance Handling	4
10.	Unions and Legal Knowledge	6
11.	Training of Workers	10
12.	Personnel Records	4
13.	Selection and Placement	2
14.	Safety	2

It was decided to conduct the training by using conference method. The Conference Leader was provided with the flow chart of each topic and he was expected to guide the discussion accordingly.

A Simple Flow Chart

DISCIPLINE

Points to be driven	Possible Approach	Lead Questions	Conclusions
What is discipline?			
Means of keeping order in the section or department. Means to secure good conduct on the part of a group of workers	To reprimand, give notice fine etc. To use law.	Why we reprimand? Give notice etc.	Because they behave wrongly: don't work; don't follow rules and regulations which affect the departmental work.
(Why Discipline)			
To obtain greater cooperation (obedience).	To punish for the wrong things—loafing, loitering, etc.	But what is the necessity of punishing, proper behaviour or respect for supervisor?	To keep good relations, to have understanding of the rules and regulations and to establish understanding between supervisor and worker.
To get the job done well.	To see they behave properly. To get respect of the workers for the supervisor.		To avoid wrong behaviour.
(What are the causes of indiscipline? Wrong behaviour? Why they behave as they do?)	Workers don't want to work. They are lazy. Unions back them: so they feel they can behave as they like.	Is it true that they don't want to work? or they are lazy. (Relate to motivation topic)	No proper instruction about the job. Emotional disturbance. (Stress temporary phases).
Lack of proper understanding of the rules. Burdensome personal problems. Lack of aptitude for the job. Feeling lack of appreciation. Intelligence (capacity) more or less than job requirements.			

Points to be driven	Possible Approach	Lead Questions	Conclusions
What a supervisor can do to avoid indiscipline?) Explain all rules fully. Show the worker how to avoid offences. Understand why he behaves that way and remove the cause.	He should tell them not to behave badly; sometimes he should forgive. Take disciplinary steps.	Are you not doing it today? What can you do to prevent, i.e. to see that the workers don't feel or don't have an opportunity to misbehave?	Put special orders in writing. Placards. Be constantly aware of employee feeling and attitudes.
(What a supervisor can do to see the person does not misbehave again?) Method of disciplining workers. (supplied)			
(Why your disciplinary actions can be challenged?) Legal aspect.	Inadequate cause. Charges are general. Severe punishment for petty offence.	What can you do to avoid it?	Get all the facts. Make sure action is deserved. Act promptly--don't delay. * Be specific in charges. Show no bias or favouritism. * Keep written records of violation and actions taken. * Administer discipline to the fullest extent needed.

The programme ran for two years and at the end, the Managing Director asked the Departmental Heads to assess the effectivenesses of the programme. Departmental Heads of the company met thrice and submitted their report. The summary of the report read as follows :—

"The group felt that the supervisory training programme has not achieved its goal....

i. Supervisors have become right-conscious and not duty-conscious.

ii. Inter-communication has shown no improvement.

iii. There has been no improvement so far as loitering, production, quality, theft, etc. are concerned. Further, it has resulted in more loitering at the supervisory level.

iv. Supervisory training has not resulted in any unfoldment or initiative on the part of the supervisors.

v. So far as the human relations aspect is concerned, supervisors are not able to maintain discipline in the department after this training as they were able to do before."

The Managing Director met the Board of Directors and his report summed up the achievements of the programme in the following words :

"We were trying to break through organisational cultures that had traditions of decades behind them....We must admit that although seepages are noticeable here and there, a breakthrough has not been achieved."

A few excerpts from the conversation which occurred immediately after the assessment meetings are presented below:—

(Personnel Officer was incharge of training activities within the company).

Departmental Head : Mr. Khanna, you may be wondering why we adopted such an extreme attitude in the meeting called for assessing the training effectiveness....I tell you, in my personal capacity, that after training these supervisors dare to show their teeth openly. I am here in this company for the last 30 years and I have never seen this sort of mischievous behaviour on the part of supervisors....Now they think of themselves to be something.... argue endlessly....previously they used to shudder while facing us.

Personnel Officer : Mr. Tandon, can't we look at this situation a little differently?....After training, supervisors have become more bold and are critical of their day-to-day problems. They have shed their indifference. After all, the dead are distinguished from the living in that the latter react to the environment in a positive way.

Departmental Head: Mr. Khanna, you are a psychologist....but I feel these supervisors have lost their sense of modesty. They have started showing their teeth.

Personal Officer : (smilingly) So you want to pull out their jaws to solve the teething problem.

(*Both smile*)

Departmental Head: You know production is so important to us. You can't maintain discipline unless people fear you.
(*Both smile and leave the place.*)

"Powerlessness corrupts...."

The Rashtria Mills Case

Kanwar Jit Singh

On June 15, 1969, a young man in his late twenties came to the Mills to join his duties as a Personnel Officer. This position was filled up with the help of a management consultant of Bombay. Mr. Kumar, the new appointee came to the office blocks of the Mills and sent a note to the Managing Director, seeking an introductory meeting. The author presents below a few excerpts from the conversation, and certain incidents which occurred at the meetings during the first three days.

FIRST DAY

PERSONNEL OFFICER: Good morning, Sir.

MANAGING DIRECTOR : Hello, Mr. Kumar ! When did you come to Ahmedabad? I am sure, you will find this city quite interesting.

(Kumar smiles. The peon enters the room with a visiting card. The Managing Director asks the peon to send the man inside—the visitor was from an International Company selling polyester fibre).

MANAGING DIRECTOR : Mr. Basu, please take your seat. I was quite worried about this heavy damage in our terycot cloth. I was myself thinking of calling you today. It is so good of you to have come. Mr. Basu, you know the damage position of our terycot cloth : it is actually the backbone of our profits.

BASU : Well sir, I have been to your Spg. Deptt. You remember you had called me twice earlier for the same problem. At both the times I requested your Spg. Supdt. (Deptt. Head) to change the present bobbin (terycot) carrying bamboo baskets. You know, polyester/cotton fibre catches dust so easily that these *topalas* (bamboo baskets) are not at all suitable for carrying these bobbins. You have got to get covered metal containers for the transhipment of terycot bobbins. I am sorry to tell you that nothing has been done so far in spite of my requesting your Spg. Master twice.

MANAGING DIRECTOR : Mr. Basu, even if you come the third time, you will find the same thing. **I am fed up with this type of staff. I do not know what to do with this rotten lot.**

(Spinning Master enters the room and occupies the next chair to Mr. Basu).

BASU : Well sir, after all, these are all technicians: they do not know how to manage or get the work done. What we need is competent managers.

MANAGING DIRECTOR : Mr. Jaichand, (Spg. Master) after all, what is the hitch in changing these *topalas*? You immediately make one prototype metal container and try it out.

SPINNING MASTER : Well sir, Mr. Roopchandji (Spg. Supdt.) is on leave: I will do it as soon as he comes back.

MANAGING DIRECTOR : Why do you have to wait for his arrival ?

SPINNING MASTER : Well sir, I will prefer to do it in his presence. (Gives a meaningful look).

(*Mr. Basu and Mr. Jaichand leave the room*).

MANAGING DIRECTOR : Mr. Kumar, you have seen **the type of people I am loaded with.** To be frank I tell you that first of all, good people never join the textile line, and if per chance some good persons join, they leave it as soon as possible; and here we are left with this rotten lot.

[*Sales Executive* (*Sales-Production coordination*) *enters the room. He starts talking while standing.*]

SALES EXECUTIVE P. C. : Sir, our godowns are totally glutted. I do not know where to put the newly packed bales. If I push it into the existing godowns, I am sure that everything will be in a mess and lot of trouble and labour may be involved to tackle the mess. We will have to arrange additional godowns.

MANAGING DIRECTOR : Mr. Gupta, I give you the guarantee that if I give you five more godowns, they will all be full within 2-3 months. Let these marketing men hurry up to sell, to solve your problem, rather than the other way round.

(*Managing Director pauses and continues*)

Well, can you give me the latest stock position?

(*Glances over the reports and exclaims*) Mr. Gupta ! ! What is this ? 1965 cloth still lying in godowns ! !

SALES EXECUTIVE PROD : Yes, sir.

MANAGING DIRECTOR : (Flares up)

Mr Gupta, call Mr. Shamlalji (Factory Manager).

(*Shamlalji enters*).

Mr. Shamlalji ! Get these 15 bales of 1965 from the godowns and place them opposite the house of Mr. Mehta (Sales Manager) so that he can see them morning and evening while coming in or out of the house.

(*Mr. Mehta's house was within mill campus. Mr. Shamlalji looks bewildered and almost blinks. Managing Director glares and continues, tense and aloud.*)

MANAGING DIRECTOR : I mean it. Go and do it immediately ! Put some watchmen to look after the bales which will be lying opposite Mr. Mehta's house.

Mr. Shamlalji leaves the place to expedite action and Mr. Gupta follows him in hurry. Managing Director looks at the Personnel Officer and continues).

Mr. Kumar, you meet our Secretary, Mr. Tandon. I have told him to make seating arrangement for you and you see me tomorrow morning again.

(*Personnel Officer leaves*)

SECOND DAY

(*Personnel Officer enters the Managing Director's room and finds Mr. Gupta already seated there*).

MANAGING DIRECTOR : Mr. Kumar, please take your seat.

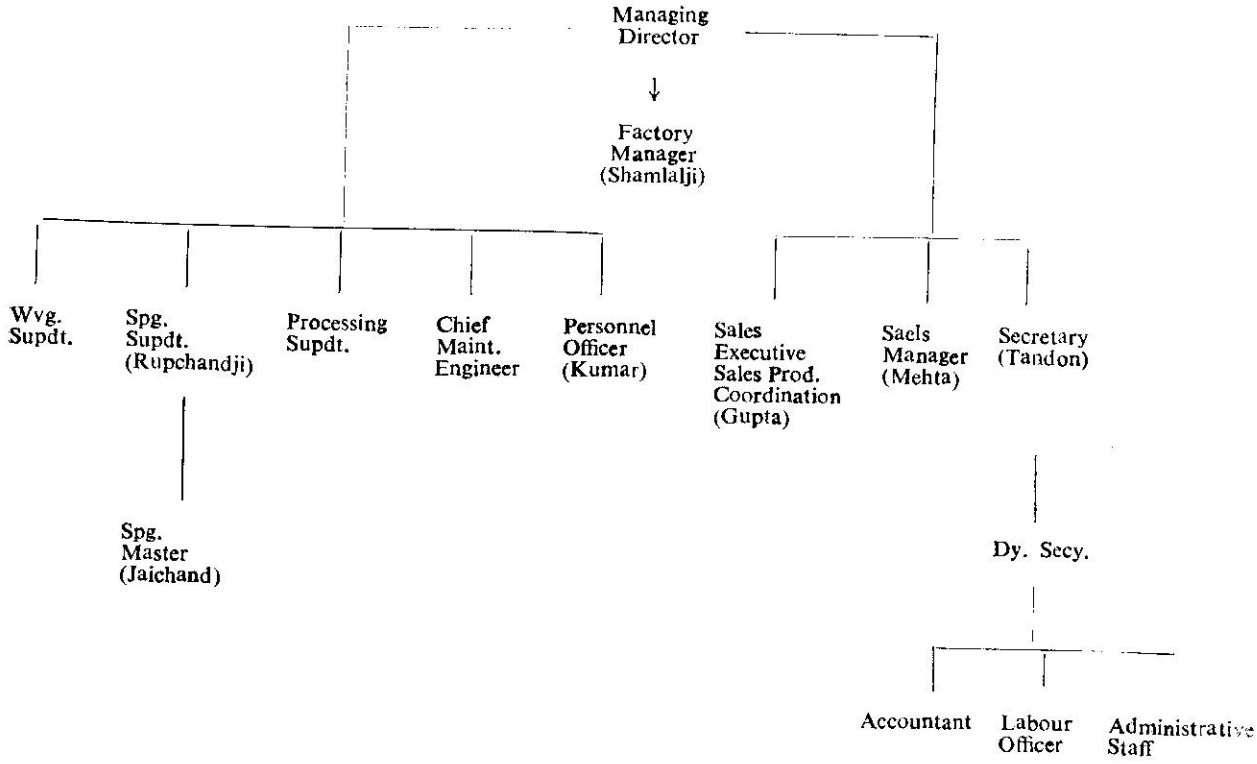
(*Looking at Mr. Gupta*)....

So Mr. Gupta, those 15 bales of 1965 are already sold out! Hmm...Gupta, you may be thinking why I was boiling up unnecessarily. Now you have seen. Why this local salesman could not sell these bales earlier? I knew it. You understand now how it works with these people.

(*Gives a meaningful look to the Personnel Officer*).

MANAGING DIRECTOR : Mr. Kumar, let us go round the departments, and you can see how we move about here.

Partial Organisation Chart of Rashtria Mills Ltd.



(*Personnel Officer nods and both leave the room.*)

THIRD DAY

(*Personnel Officer and the Managing Director are both sitting in the latter's air-conditioned chamber.*)

MANAGING DIRECTOR : I am giving you one problem. Please study it and report back to me as early as possible.

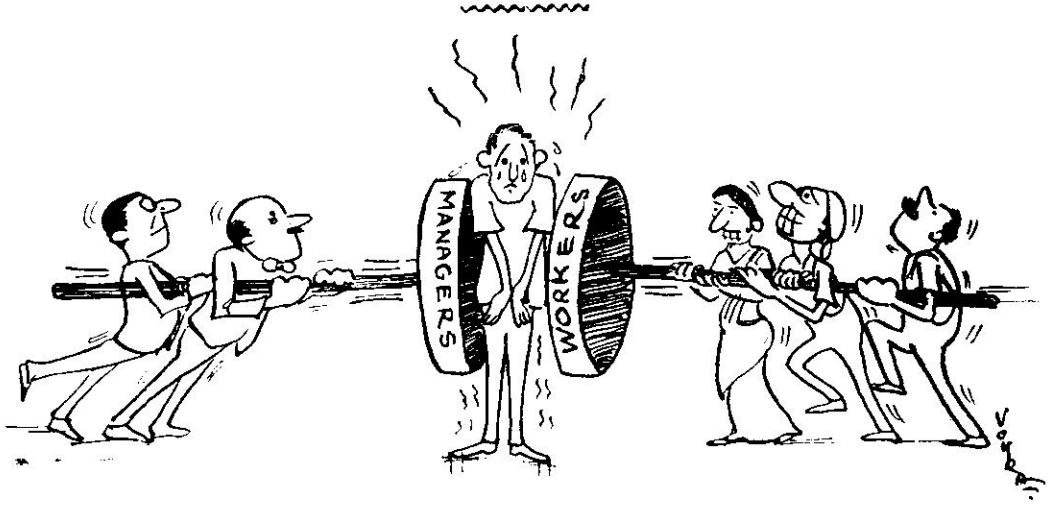
Well ! Five months back I recruited the Spinning Master, Shri Jaichand, whom you have already met. He possesses a degree in science and another degree in textile technology. He is 33 and has got two children. Apparently, he was very healthy and was a well poised man. He has a brilliant academic record. Further, he has got 10 years' continuous experience in a top flight mill of India, where he joined as supervisor and he was Sr. Asstt. when he left, to join us. Personally I found him to be a very sound technician.

(*Managing Director continues.*)

MANAGING DIRECTOR : Our present Spg. Supdt. is already 70 (though his wife is only 32). I made this appointment with the view that after his retirement we will have a capable and tried man immediately available. The new Spg. Master worked for 3 months and then I heard that he is getting some difficulty in sleeping and is often absenting himself from work. My information is that the man never suffered from insomnia before joining this mill. I suspect that the Spg. Supdt. is making his life difficult in the mill. Though I have asked him personally about his difficulties, but he does not speak out his problems to me. Rather he shows a son-like attitude towards the Spg. Supdt. Mr. Shamlalji, our Factory Manager, when he first told me about his insomnia, I thought, maybe the man is suffering from insecurity; so I immediately cut his probation period short and confirmed him. Rather, I appreciated his efforts in the department. But now I hear that he is under the treatment of a local Psychiatrist, Dr. Phadke and is getting shock treatment (ECT). He is now much more irregular in attendance.

(*Managing Director pauses.*)

I do not know what to do. I personally feel partly responsible for the plight of the man. I do not want to be unfair, but I have to take action.●●●

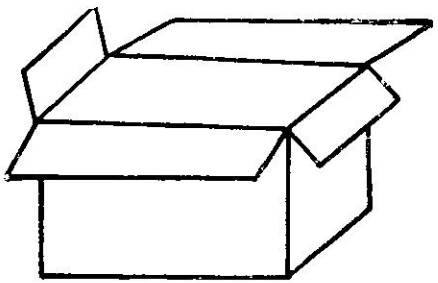


Value Analysis of A Packing Container

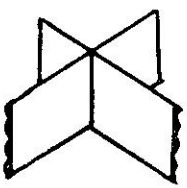
DP Mondal & R Krishnan*

In this case study in Value Analysis of a Packing Container, the authors have worked out how by replacement of a hardboard carton with partitions, paddings and M.S. starp by corrugated paperboard case and paper tape, a saving of over 20 per cent in cost has been achieved.

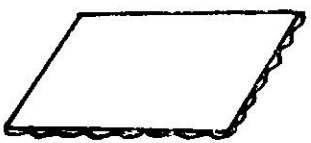
Present Carton



1.
Hardboard Carton



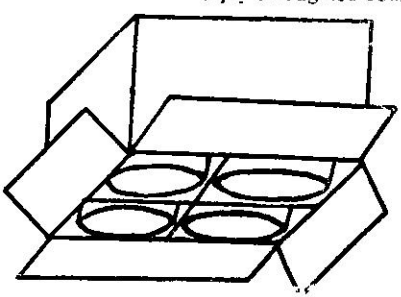
2.
5-ply corrugated board partition



3 & 4.
Top and bottom pieces — 3-ply corrugated board

5.
M.S. Strap

6.
Clip



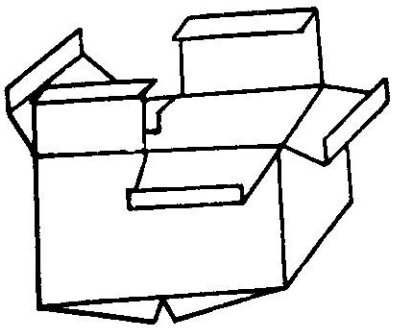
Packed Carton

Functional Analysis of carton parts

Parts	*Verb*	*Noun*	*Present Cost*
1. Hardboard Carton	Contain	Cans	Rs. 2.20
2. Partition	Separate	Cans	0.40
3. & 4. Top & Bottom Pieces	Absorb	Shock	0.40
5. M.S. Strap	Bind	Carton	0.38
6. Clip	Join	Strap	0.02
		Total	Rs. 3·40

* Work Study Department, The Alkali & Chemical Corporation of India, Rishra, West Bengal.

Proposed Carton



1
Corrugated board carton—5-ply
(tuck-in-type)

2
Glued paper tape

Cost Involved for Parts:

1	Carton	Rs. 2.50
2.	Paper Tape	0.10
	Total	Rs. 2.60

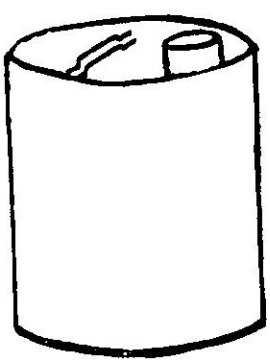
Savings Achieved

Rs. 3.40—Rs. 2.60=Rs. 0.80; i.e. 24% reduction in cost.

CASE EXAMPLE II

Replacement of 2" diameter Tri-Sure bung of 20 L. M.S. drum by 3-inch diameter lid.

Present Drum



20 L,M.S. drum

2" wide mouth
(threaded inside)

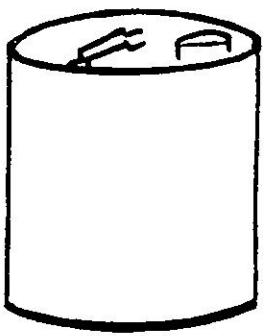
2" dia-Tri-Sure bung
(threaded outside)
made of imported alloy

Cap Seal

Functional Analysis

Parts	FUNCTIONS *Verb*	*Noun*	*Actual Cost Incurred (Rs.)*
1. Drum	Contain	Liquid	6.25
2. 2" dia Tri-Sure Bung	Proof	Leakage	2.00
3. Cap Seal	Prevent	Pilferage	0.25
		Total	Rs. 8.50

Proposed Drum



3" dia mouth
(not threaded)

20 L. M.S. drum

3" dia. M.S. Lid with rubber coat on outside (without thread)

Cap Seal

Cost Involved

Drum		Rs. 6.00
Lid		0.50
Cap Seal		0.25
	Total	Rs. 6.75

Net Savings Achieved

Rs. 8.50 – Rs. 6.75 = Rs. 1.75; i.e. 21% in cost

"One must ration carefully his generalisations concerning the fate of man."
—Galbraith

Value Analysis

A Case Study in Paints

R Krishnan*

A PAINTS PLANT WAS USING ABOUT 100 TONNES of solvents, costing around Rs. 3.5 lakhs per annum for cleaning various equipments in the plant. A Method Study/Value Analysis team was formed to suggest ways for reducing the cost of solvent consumption and improving the methods of cleaning.

As a result of the studies it was found that the cost of cleaning could be considerably reduced by using alternate solvents, solvent blends or water-solvent emulsions of low cost and having a rigid control on losses due to wastage and evaporation.

Implementation of the proposals was expected to bring down the cost of cleaning solvents from Rs. 3.50/Kg to Rs. 0.75/Kg and the quantity from 100 tonnes to 80 tonnes per annum, resulting in an annual savings potential of Rs. 2.9 lakhs. The implementation was taken up in phases and resulted in a savings of about Rs. 1.7 lakhs during the first year.

Findings

About 100 tonnes of good solvents along with 22 tonnes of recovered solvent (recovered by distilling used solvents) were being used. Good solvents used, consisted of 15 varieties with cost ranging from Rs. 0.47/Kg to Rs. 5.50/Kg, with an average cost of Rs. 3.50/Kg. Solvent 'A' of cost Rs. 3.65/Kg formed 90% of the total consumption of good solvents. This solvent had the highest evaporation rate among all the solvents used. About 50% of the total consumption was in section '1' and the rest 50% in sections '2' & '3'.

*Work Study Department, The Alkali & Chemical Corpn., Rishra, West Bengal

A considerable portion of the solvents was lost through evaporation, spillage etc. Out of 100 tonnes of good solvents used, only 40 tonnes were returned to solvent still for distillation and recovery. Studies carried out indicated that a substantial reduction in the consumption of solvents for cleaning could be achieved by

(a) Standardisation of the type of solvent used

(b) Improvement in the method of cleaning

(c) Control on losses due to evaporation and spillage.

Mechanism of Cleaning

A critical examination of the mechanism of cleaning revealed that

i. A cleaning medium is required to detach the contamination from adhering surface.

ii. A carrier is required to spread the cleaning medium over the surface and subsequently wash off the surface.

A strong solvent is required for satisfying the first function whereas any liquid will be able to carry out the second function. Thus by suitably mixing the strong cleaning solvent with other solvents of lower cost or with water using emulsifier, if necessary, it will be possible to achieve the required degree of cleaning.

Standardisation of the Use of Solvents

Solvent 'A' of cost Rs. 3.65/Kg formed a major portion (90%) of solvents consumed towards cleaning.

Experiments carried out indicated that except for one type of contamination, say 'arkay', the other types could be cleaned for varying degrees by cheaper solvents like solvent 'B' of cost Rs. 0.47/Kg and solvent C of cost Rs. 0.65/Kg. But, for the particular 'arkay' contamination solvent 'A', was necessary. In practice, solvent 'A' of high cost and high evaporation rate were being utilised for cleaning all contaminations, accounting for the high overall cost of consumption.

It was also found that considerable material savings could be achieved by adding the used solvents (solvents obtained after cleaning) in the manufacturing process wherever possible.

In the light of the above findings the following recommendations were made :—

(1) In Section 1, where miscellaneous equipments are cleaned, the equipment with contamination other than 'arkay' should be cleaned by solvent 'B' of cost Rs. 0.47/Kg. Equipment with 'arkay' contamination should be cleaned by an optimum blend of solvent 'A' (cost Rs. 3.65/Kg.), solvent 'C' (cost Rs. 0.65/Kg) and water. This optimum blend was arrived at by experimenting with different blends and fixing the minimum quantity of active solvent, i.e., solvent 'A' required. Here solvent 'C', acts as an emulsifier also. The cost of the blend is Rs. 0.81/Kg.

(2) In other sections, contamination other than 'arkay' should be cleaned by solvent 'B' and contamination 'arkay' be cleaned by an optimum blend of solvents 'A' & 'B'. The cost of the blend will be Rs. 1.43/Kg. Here the blend suggested earlier in section '1' cannot be used due to the presence of water.

The above blend of solvents recommended should be supplemented by recovered solvent, wherever possible, thereby reducing the consumption of fresh solvents.

Also, fresh solvent used should be consumed in the process, if possible.

Methods of Cleaning

It was found that about 50% of the solvents were consumed in Section '1' and the rest 50% in Sections '2' & '3'. The method of cleaning followed and recommendations given to improve the same were as follows :

(1) In Section '1' mainly small components were cleaned. Cleaning was done by immersing the components in the solvents in open tubs and scrubbing by brush. Periodically the solvent from tubs was collected in open drums and sent to recovery Section. Studies indicated that handling loss of solvent in this section was to the extent of 35-40% and was mainly due to evaporation/spillage from the open tubs.

An examination of possible alternatives indicated that the use of a closed tub with arrangement for recirculation and spraying of solvents would reduce evaporation/spillage losses. A suitable solvent cleaning machine was designed for the purpose.

(2) In sections 2 & 3, solvent was used to rinse the equipments after processing a batch. The used solvent was being collected in open drum and transported to the Recovery Section.

It was recommended that the solvents used for initial cleaning should be such they could be utilised in the manufacturing process, thereby saving material. Also a suitable solvent blend should be used for final cleaning and the used solvent should be collected in a closed drum and transported to Recovery Section.

Control of Wastage

If was observed that losses of solvents were incurred due to

(1) Evaporation during cleaning
(2) Evaporation during storage
(3) Spillage

Steps suggested to reduce the losses through evaporation during cleaning have already been discussed. (i.e. mixing with slow evaporating solvent, emulsification etc., and cleaning in closed vessels.)

Steps suggested to bring down the evaporation during storage and spillage were as follows:

(1) Collection of used solvents strictly in vessels provided with lids.

(2) Ensuring that the used solvents after collection from cleaning sections are despatched immediately to the solvent recovery section and stored in suitable drums provided with lids.

(3) Introducing simple recording procedures to have proper accounting of solvent consumption and recovery in order to exercise better control.

Introduction of the above prospective measures and better controls resulted in reduction of wastage of solvents. The percentage of used solvents arriving at the Recovery section to the fresh solvents issued, went up progressively from an average of 40% to 65% in 3 months.

Solvent Recovery Section

Recovery of solvent from used solvent is done by distillation. Used solvents from different sections were being sent to Recovery section in various drums. Periodically the solvents were pumped into an underground tank. After settling the slag, the solvents were pumped into Recovery Still and distilled. Recovered solvent was stored in a closed tub and was drawn from the tub by various users.

To have proper control on consumption, it was suggested that used solvents from the major sections should be collected in separate drums in Recovery Section and periodically weighed and unloaded into the underground tanks. The solvents returned from each section for recovery should be compared with the quantity of fresh solvent consumed, periodically. This would immediately show the extent of wastage in that particular section. It was also suggested that issue of recovered solvent to different sections should be done against 'Requisition' in order to discourage the indiscriminate use of solvents.

Conclusion

The potential of the proposals suggested were discussed in detail with all persons concerned, and implementation was taken up in phases. As a result, the quantity and cost of solvents consumed for cleaning came down by about 55% and 70% respectively in 4-5 months. Though the quantity of solvents consumed was reduced considerably in a short period, the solvent blends suggested could be implemented only in phases.

Every month, a consolidated statement on the consumption of solvents in different sections is prepared and circulated to the Section in-Charge concerned, with the Superintendent's comments. Possible scope for further improvement is pointed out in the statement.●●●

APRPBWPRAA

" 'Conrad Hilton, an inspiring friend of mine for many years, magnificently demonstrated positive thinking in his victory over adversity in building his vast hotel empire.' Another friend, Norman A. McGee of Savannah, Georgia, built up a $2m. oil company from nothing but 'persistence and faith' *and a good wife.* **Jack Smith, an ex-prize-fighter friend, kept a sign on his desk bearing this message : APRPBWPRAA, and successfully built up a chain of health clubs. The letters stood for Affirmative Prayers Release Powers By Which Positive Results Are Accomplished."**

—Norman Vincent Peale

Container Shape Reduces Packing Cost

Sanwar M Misra*

A package container communicates outwardly the product image to the customer and acts as a silent salesman. Whether its appearance creates a non-conformist appeal, we have no measure of this intangible parameter at this stage. While we lay down that its design should be a functional one, irrespective of any showmanship, it should fulfil the objective to carry the product most comfortably to the destination, undamaged. Marketing policy may determine the adoption of a package container more expensive than the optimum size, but this departure should be justifiable in terms of value analysis.

WE FIRST CONSIDER THE WOODEN CONTAINER commonly used as the final package for the safe transport of goods over long distances. It has enjoyed a glorious past in packaging history and is still fighting lit against the near-destructive handling conditions prevailing at our railways. Cartons dare not take its place, at least in such areas where the journey of goods is susceptible to damage from the impact of crushing leads, menaced by jerks and jolts. Of course, some light and careful handling situations are encouraging the cartons to enter into the Indian packaging field, and grow up. All this, however, does not prove that the wooden case will be knocked out of use as a package container in the near future. Keeping the principal aim of an economic container in mind, we can explore some cost cutting moves towards designing it. This may comprise of a multitude of factors for a given product, e.g. product shape, container design, fragility factor, plank thickness, method of manufacture etc. etc. Irrespective of these factors, the container shape offers a potential area of investigation and study to achieve cost reduction. To comprehend the implications of shape-consciousness—not applied to the beauty contest, but to the wooden container—a gainful analysis is presented through an illustrative example drawn from the factory floor.

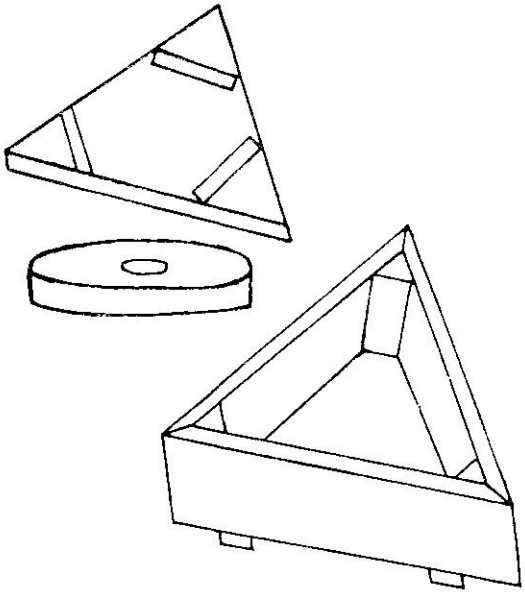
To contain a product an enclosure is required. Geometry tells us that a minimum of three lines crossing one another make such an enclosure, called the triangle. We may go a step further, add one more line to this figure and make a rectangle. Rectangular shape has been the most common for container design. We can keep on adding lines: we get a pentagon, then a hexagon etc. etc., and if we continue to add such infinite lines, we end in a circle. Reducing the problem to manageable size, we may discuss the four geometric figures as the possible container shapes: triangular, rectangular, hexagonal and circular.

To illustrate this situation, let us consider an abrasive wheel of 24" outside diameter, 4" thick and weighing 30 kg., to be packed in a

*Industrial Engineer, Kota (Rajasthan)

wooden container with 1″ layer of cushioning of a packing medium, e.g. packing grass or saw dust, around it. A wooden container is to be designed, having plank thickness of 5/8″, batton thickness of $\frac{3}{4}$″ and of 3″ width.

Calculation of the packing wood requirements for these four shapes is given here.



Triangular Container

Wooden planks of the three sides are joined together by means of corner blocks and six battons are nailed to the bottom and top lid of the case. The case height is six inches—to accommodate a four-inch thick wheel—leaving one inch packing clearance around the periphery and top and bottom faces of the wheel.

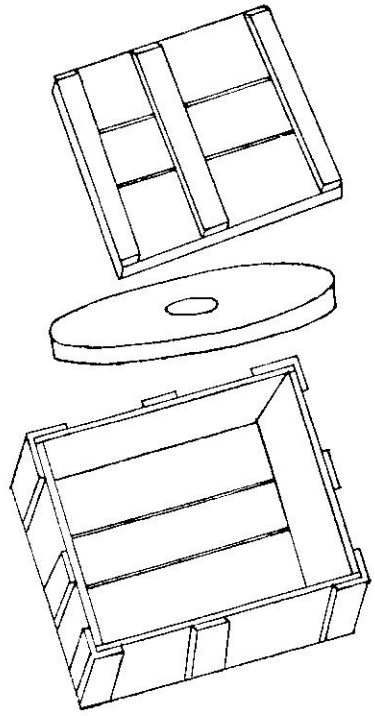
PACKING WOOD REQUIREMENTS

Item	Measurements in inches	Cu.in. of P. Wood
(i) Bottom and top planks	$37/2 \times 47 \times \frac{5}{8} \times 2$	=1088
(ii) Three sides	$47 \times 6 \times \frac{5}{8} \times 3$	=530
(iii) Three corner blocks		=36
(iv) Six top and bottom battons	$8 \times 3 \times \frac{3}{4} \times 6$	=108
Total		=1762cu.in.

Approximate net weight of the container (consider 11.6 gms/cu.in. as density of packing wood) =20kgs
Volume of the container =5200 cu. in.

Rectangular or Square Container

Construction: Inside measurements of this case are 26″×26″×6″ (height). Side planks are joined together by a pair of corner battons. The case top and bottom are assembled with three battons each on the top and bottom cover. Additionally, four side battons are provided at the middle.



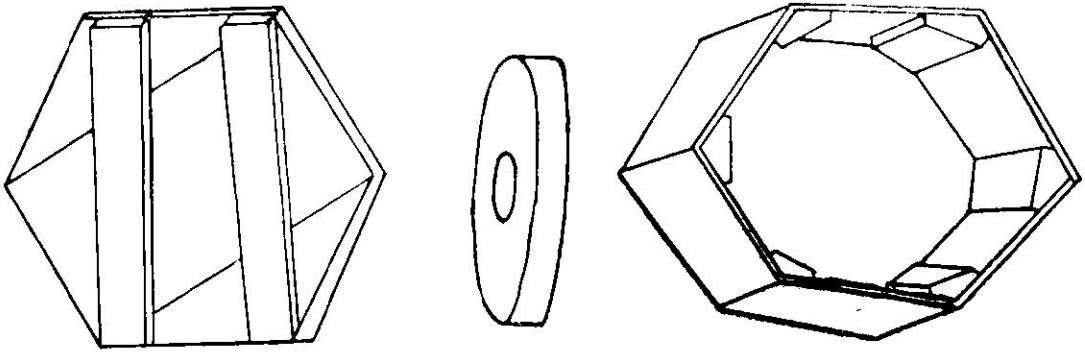
PACKING WOOD REQUIREMENTS

Item	Measurements in inches	Cu.in. of P. wood
(i) Side Planks	27.5″ × 6″ × $\frac{5}{8}$″ × 2	=207
	26″×6″× $\frac{5}{8}$″ × 2	=195
(ii) Side & Corner battons	7.5″×3″× $\frac{3}{4}$″×12	=203

(iii) Top & Bottom	27″x9″x3″x$\frac{5}{8}$″x2	=913
(iv) Battons for top & bottom	29″x3″x$\frac{3}{4}$″x6	=392
Total		1910 cu. in.

Approximate net weight of the container =22 kgs
Volume of the container =4056 cu.in.

Hexagonal Container



Construction:

The inside of this case measures 26″ across flats and a height of 6″ is kept. The six sides are joined together with six inside corner blocks. The top and bottom are provided with two battons each.

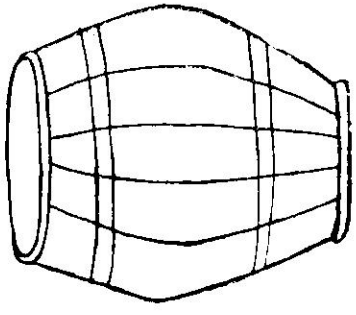
PACKING WOOD REQUIREMENTS

Item	Measurements	Cu.in. of P. wood
(i) Sides	15″x6″x$\frac{5}{8}$″x6	338
(ii) Top & Bottom	26x15x$\frac{5}{8}$x2+16x26x4x$\frac{5}{8}$ 2x2	487+270
(iii) Inside corner blocks		54
(iv) Battons	26x3x$\frac{3}{4}$x4	234
Total		=1383 cu″.

Approximate net weight of the container =16 kg.
Volume of the container =3510 cu.in.

Circular Container

The circular container conforms to the barrel shape. Since the barrel cannot be made with commonly available skill for case making in various sizes and wherever desired, it may be dropped for this comparative study. However a barrel shape is more economical in terms of packing wood consumption but for the higher manufacturing cost and costlier wood required for making a barrel shape.



The computed data are tabulated on the next page for comparison.

Container Data	Triangular	Rectangular	Hexagonal
(i) Packing wood required	1762 cu. in.	1910 cu. in.	1383 cu. in.
(ii) Volume of the container	5200 cu. in.	4056 cu. in.	3510 cu. in.
(iii) Net weight of the container	20 Kg.	22 Kg.	16 Kg.
(iv) Volume of packing medium	3400 cu. in.	2256 cu. in.	1710 cu. in
(v) Weight of packing medium at 70% compaction (10 Kgs./cu. ft—density)	14 Kg.	9 Kg.	7 Kg.
(vi) Estimated gross weight	64 Kg.	61 Kg.	53 Kg.

*Wheel volume is 1800 cu. in.

In the above calculations, waste has not been considered which is approximately the same for all shapes.

COST COMPARISON

Component Cost	Triangular	Rectangular	Hexagonal
(i) Packing wood cost (@ Rs. 10 per cu. ft.)	Rs. 11.20	Rs. 11.10	Rs. 8.00
(ii) Packing medium cost (@ 15P per Kg—hay, saw dust)	,, 3.00	,, 2.00	,, 1.50
(iii) Freight cost (@ 12P per Kg.)	,, 7.60	,, 7.32	,, 6.36
(iv) Estimated manufacturing cost	,, 0.75	,, 0.50	,, 1.00
Total	Rs. 21.55	Rs. 20.92	Rs. 16.86

Comments

From the cost figure, the hexagonal case clearly establishes its superiority over the triangular and the rectangular or square case. The industry using rectangular containers for packing circular product, and spending every year lakhs of rupees worth of this much-needed packing wood, can help the country to conserve forest resources and also reduce its packing cost. A hexagonal case saves 28% on packing wood over the rectangular.

The hexagonal case uses less packing wood, hence has reduced container weight. It has less volume and so it requires less packing medium weight. This also leads to savings in freight; and all this is achieved, without compromising on container strength or discomfort to the product.

The hexagonal container has already been tried out by actually subjecting it to the rough railway handling and also giving it drop tests, crushing and vibration tests, etc. Due to its multicornered shape, it is easier to be rolled away: thus minimising the effort in handling.

The hexagonal case uses smaller lengths of wooden planks for fabrication, while the rectangular case requires longer planks which cost comparatively more.

In the days to come, the hexagonal case may set the trend in packaging for wooden cases. It breaks the monotony of the rectangular shape, and promises cost reduction.

APPENDIX

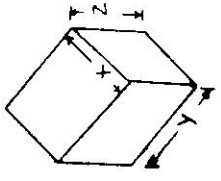
The author had submitted earlier a simpler exposition of the same container problem. It appears worth while printing it as a supplement to the main article.

Case Size Determination For Minimum Material Consumption

After exploiting the benefits of shape-design the size of the container can be further optimised for a given volume, resulting in a minimum of container material consumption in mass-manufacturing. Such a situation is most commonly encountered where the product is bulk packed and the container does not have to be made to suit the size of the individual item to be packed.

Packaging of all bulk-materials and also of small-sized items, whose volume decides the container-size, can be considered for optimum case size determination. For a given volume of the container dimensions -length, width etc. can be derived so that the material required for making it is minimum.

To illustrate, let us consider a rectangular container having 4 c. ft-volume and a height of 1 ft.



Let x be the width of container
y „ length „ „
z „ height „ „

$\therefore$ Total surface $(S) = 2xz + 2xy + 2yz$ ....(1)

Volume $(V) = xyz$ .....(2)

Since volume is 4 c. ft and height is 1 ft. we have

$$y = 4 \text{ or } y = \frac{4}{x} \quad \ldots\ldots(3)$$

substituting this value of y in (1), we get

$$S = 2x + 8 \div \frac{8}{x} \quad \ldots\ldots(4)$$

For 'S' to be minimum $\frac{ds}{dx} = 0$

Differentiating equation (4), we get,

$$\frac{ds}{dx} = 2 - \frac{8}{x^2} = 0$$

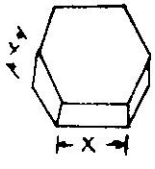
$\therefore x = 2$ ft and $y = 2$ ft.

Hence the most economical container size for 4 c. ft volume is 2 ft $\times$ 2 ft $\times$ 1 ft (square container).

The surface area of this square container is 16 sq. ft. $(S = 2x2 + 8 \div \frac{8}{2} = 16)$ for 4 c.ft volume.

For the same volume, we can alternatively have a container of size 4 ft $\times$ 1 ft $\times$ 1 ft, but it will require, $S = 8 + 8 + 2 = 18$ sq. ft. of material, which means an extra 2 sq. ft of material per container.

A similar illustration for a hexagonal case is as below.



Let the volume (V) be equal to 2 cft.
x be the length of each side
y the height of the container

$\therefore$ volume $(V) = 1{\cdot}73x^2y + 0{\cdot}86x^2y$
$= 2{\cdot}6x^2y = 2$ .....(1)

Total surface $(S) = 6xy + 5.2x^2$ .....(2)

From equation (1), $Y = \frac{2}{2{,}6\ x^2}$; substituting this value in equation (2), we have $S = \frac{12}{2.6x} + 5.2\ x^2$

Differentiating, we get;

$$\frac{ds}{d} = \frac{12}{2.6\,x^2} + 10.4\,x = 0$$

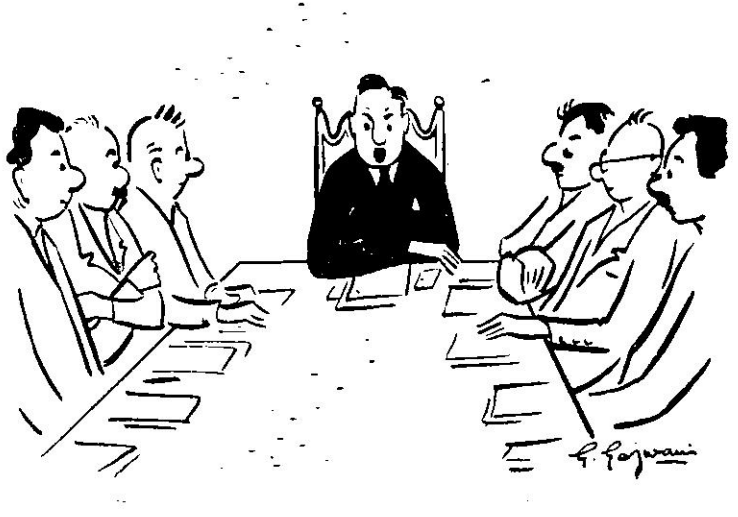
$\therefore$ $x = 0.76$ and $y = 1.33$

For the given volume of 2 cft., length of each side and height of the hexagonal case should be as described above, so that minimum material is consumed in its construction. Similarly, the size of a cylindrical container can be determined for minimum material consumption.

To sum up, we have known the economics of a hexagonal case in a given situation, where a circular abrasive product is packed individually. Here the product size determines the container size. For the given volume, length or width of the case cannot be varied for minimum material consumption, in this case.

Alternatively, for bulk-packing items, the dimensions of the container can be varied for a given volume. Here the case-shape may not be necessarily a hexagonal one and can be rectangular, triangular, cylindrical etc. Under such a situation, the container dimensions can be derived by using differential calculus method for minimum container material consumption.

Application of this approach can bring tremendous savings in manufacturing and construction activities in the country. For example the dimensions of the familiar water-tank at our railway stations, in cities, factories etc., can be thus determined and tonnes of steel and cement saved. The tin-container used in our country for packing bulk materials offer an area of potential investigation and savings of substantial magnitude. The long cylinder shaped talc powder tin may be an attractive shape, but it certainly consumes more material per tin. For the same volumetric content, the dimensions can be determined for minimum material. In the same way the packaging container size, whether it is a carton for a wooden case or metal drum, can be economically found, effecting continuous savings to the industries and consequently to the national resources of wood and metal. ●●●



Application of Value Analysis to Make Or Buy Decisions

GD Sardana*

Very often it is observed that a particular item can be made in the factory's shops or purchased from an outside source. A Production Planning man has to do the appraisal of the relative merits of the two alternatives: MAKE or BUY. Sometimes he has to choose a middle-of-the-road policy, that is, *keeping both the alternatives alive*. It is the intention of this article to show as to how the various courses of action can be evaluated in their true perspective and the most economical one selected through the application of the technique of Value Analysis.

STANARDD REFERENCE BOOKS ON PRODUCTION and inventory management list the factors which go to determine Make Or Buy decisions. These decisions are generally made through rules of thumb and hunch, vague considerations of modernity etc. A rational decision, however, can only be taken on the basis of a close economic analysis of the proposals, and a reasoned evaluation of all the factors involved in the problem.

Carlos Fallen[1] recommends the construction of a decision matrix to arrive at an economical choice, for it helps to analyse and recognise the functionality of each item by splitting all the basic requirements into elements, which are then evaluated. An alternative with the highest score (value) is the most economical choice.

*Heavy Electricals Ltd., Bhopal.

1. Value Engineering in Manufacturing, 1967, (STME Publication) Prentice-Hall Inc.

What is a Decision Matrix ?

A Decision matrix is essentially an evaluating technique. Any problem, product or a function being analysed is split into a number of elementary requirements, which are then awarded weights on the basis of their relative importance, in such a manner that the sum total of these requirements expressed in digits is unity. The weights are then arranged in a matrix which enables one to know at a glance the best choice under the given and assumed conditions.

A particular Make Or Buy decision has to accomplish certain ends or to fulfil the desired requirements of the item being evaluated. Some of these requirements can be enumerated as

(a) Utilisation of factory capacities
(b) Use of available technical know-how in the factory

(c) Price advantage

(d) Delivery schedule

(e) Keeping alive alternative sources of supply, etc.

Let $R_1, R_2, R_3 \ldots\ldots\ldots R_n$ be the requirements of an item being evaluated. If all the requirements were equal in importance, each requirement could be given a digit equal to $1/R_n$. However, we presume, (and this is so in practice), that all the requirements are not equal, and they vary in relative importance. Each of the requirement digit, that is $1/R_n$ shall, therefore, be multiplied with a varying factor so as to get the weighted importance. If these multiplying factors (weights) be denoted by f_1, f_2, $f_3 \ldots\ldots$the corresponding requirement digits shall then become,

$$\left(\frac{f_1}{R_n} = W_1\right), \left(\frac{f_2}{R_n} = W_2\right), \left(\frac{f_3}{R_n} = W_3\right)$$

However, the sum total of all these should still remain unity so that

$$W_1 + W_2 + W_3 = 1$$

Multiplying varying factors as denoted above by $f_1, f_2, f_3 \ldots\ldots$require a careful fixation, depending upon the particular case being considered.

An item urgently required in the shops must have the highest weight attached to it, on account of 'delivery schedule'. Over a period, however, price advantage' has to have a major weightage; also in the interest of economy, 'utilization of factory capacities' cannot be ignored, especially when spare capacities of men and machines are available.

Alternatives

In deciding whether to Make Or Buy, the alternatives are: (a) Make all (b) Buy all (c) Make 75%, buy 25% (d) Make 50%, buy 50% etc. By moving cautiously between extremes, we may approach the nearest to the best of the alternatives under the given circumstances.

Efficiencies and Their Normalisation

Assuming that $A_1, A_2, A_3 \ldots\ldots A_n$ are the different alternative proposals for the item being evaluated, with each alternative showing a different efficiency under each requirement. For example, a Make All decision provides the maximum utilisation of factory capacities, but cuts off the requirements of keeping alive alternative sources of supply.

On the other hand, a Buy All decision renders minimum the utilization of factory capacities but fully caters to the requirement of keeping alive alternative sources of supply. It is, therefore, necessary to measure the various efficiencies of different alternatives under a common standard scale so that a clear comparison and evaluation of choices can be made: This is suggested to be done through normalization. In normalization (and this is applicable to all efficiencies) two datums notifying the 'Worst' and the 'Best' are fixed. In between these two datums the relative positions of various alternatives are determined keeping in mind what relationship (colinear etc.) exists between alternatives and requirements.

Though any two datums of efficiency between 0% and 100% can be fixed, for purposes of this article a lower datum of 50% and the higher datum of 80% shall be considered.

As explained earlier, each of the weighted requirements $W_1, W_2, W_3 \ldots\ldots W_n$ reacts differently under different alternative proposals.

Let the reaction or the efficiency under a given proposal, be denoted by letter E. Under alternative A_1, the weighted requirement of W_1 may have efficiency of E_{11}, and W_2 that of E_{12} etc. Similarly under alternative A_2, the efficiency of W_2 may be denoted by E_{22}, and so on and so forth. Efficiencies so determined if multiplied with corresponding weighted requirements $W_1, W_2 \ldots\ldots$etc. provide the values. The maximum value so obtained denotes the best economical alternative.

Weight Alternatives	W1	W2	W3	—	Wn	Values
A1	E11 W1E21	E12 W2E12	E13 W3E13	—	E1n WnE1n	W1E11 + W2E12 + — + WnE1n
A2	E21 W1E21	E22 W2E22	E23 WnE2n	—	E2n	W1E21 + W2E22 + — + WnE2n
A3	E31 W1E31	E32 W2E32	E33 W3E33	—	E3n WnE3n	W1E31 + W2E32 + — + WnE3n
—	—	—	—	—	—	—
An	En1 W1En1	En2 W2En2	En3 W3En3	—	Enn WnEnn	W1An1 + W2En2 + — + WnEnn

Arrangement of Matrix

The Matrix provides a very convenient method of tabulating all available information for enabling us to read the results at a glance. The weighted requirements, alternative choices, different efficiency figures and values as discussed above are arranged in the matrix above.

Illustrative Example

M/s. Alpha Beta Ltd.* have an aggregate (uniformly distributed) annual demand of 600 pieces of part No. 9825007. This item can be die-cast at their works at a price of Rs. 420.60 each, to which may be added Rs. 41.50 for machining per piece; thus the final make piece is Rs. 462.10.

M/s. Alpha Beta are fully equipped with their present two sets of dies to meet the full demand. An outside vendor, M/s Centrifugal Ltd.*—specialists in the line—have made an offer to supply it at a price of Rs. 387.10 each. The centrifugal casting offered by this party carries a better finish and requires less machining. Machining charges in this case come to Rs. 36.50 each. Thus the total Buy piece is Rs. 423.60, as compared to Rs. 462.10, the final make piece.

The decision to be taker is whether this should be purchased or made, and to what extent. The extreme alternative courses are 'Make All' and 'Buy All'. In between these two we can also introduce, 'make 25% buy 75%', 'make 50% buy 50%', 'make 75% buy 25%', etc. etc. The essential points in the Problem are :

(1) Price advantage (2) Prompt delivery (3) Effect on factory load.

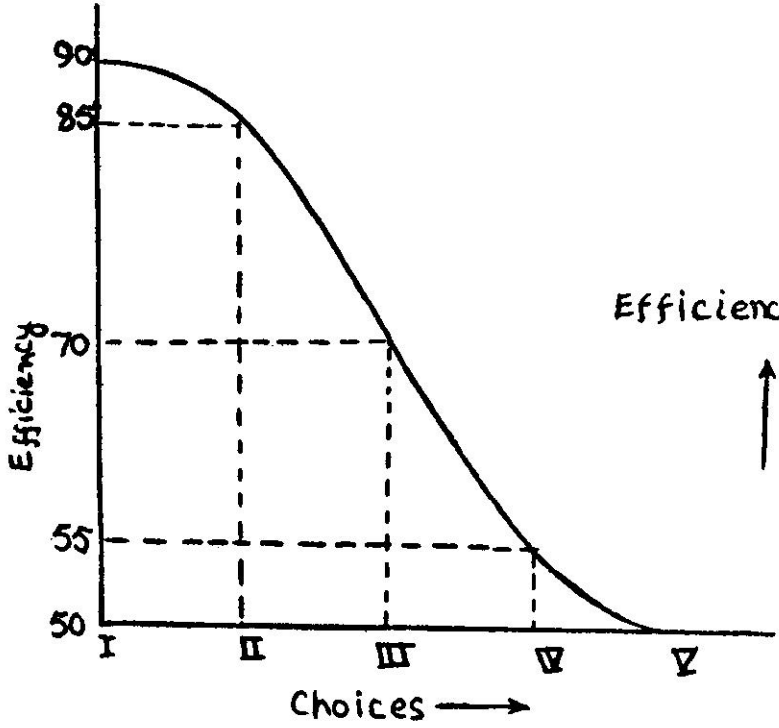
The following weightings were decided :

Price advantage	— W_1	— 0.5
Prompt delivery	— W_2	— 0.3
Effect on factory load	— W_3	— 0.2

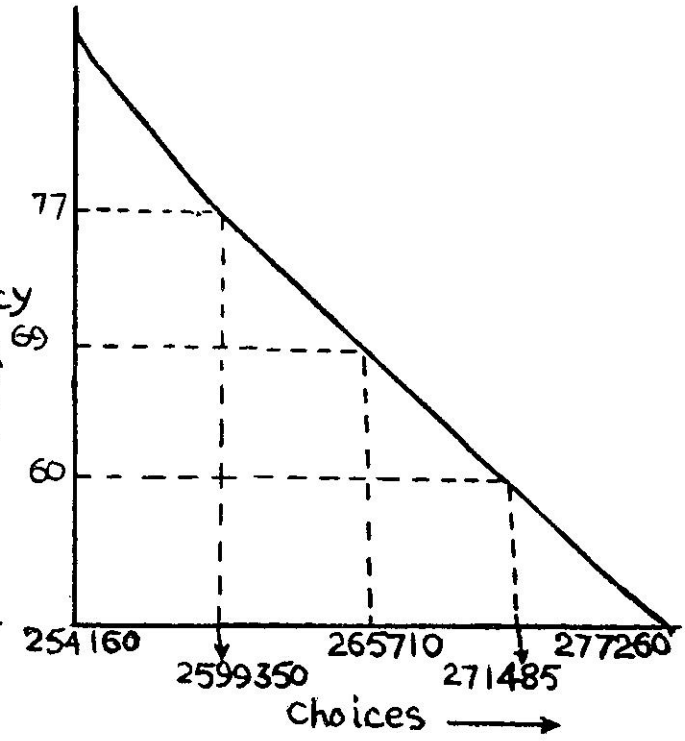
Calculation of Efficiency Figures

Calculations of efficiency figures for various alternatives is done through normalization of actual figures, that is by conversion of actual

* Names are fictitious; however, the figures used are real, and have not been changed. They are reproduced here with the permission of the original concern, called by the *nom de plume* of M/s Alpha Beta Ltd.



Graph II



Graph I

figures into commensurable units between the two assumed datums. The datums chosen in this example are 50% for the lowest (least economical) and 90% for the uppermost (most economical).

(a) Thus for price advantage, normalized efficiency figures shall be read from Graph I :

Alternative	Total Value (Rs.) (year's demand)	Normalized Figure
1. Make all	277,260/-	50
2. 75% Make, 25% Buy	271,1485/-	60
3. 50% Make, 50% Buy	265,710/-	69
4. 25% Make, 75% Buy	259,935/-	77
5. Buy all	254, 160/-	90

(b) For considering the factor of prompt delivery a knowledge about the Vendor's works, (regarding its capability to meet the demand) is essential. However, as a general rule it can be accepted that a more prompt delivery shall be available from 'make your own' policy.

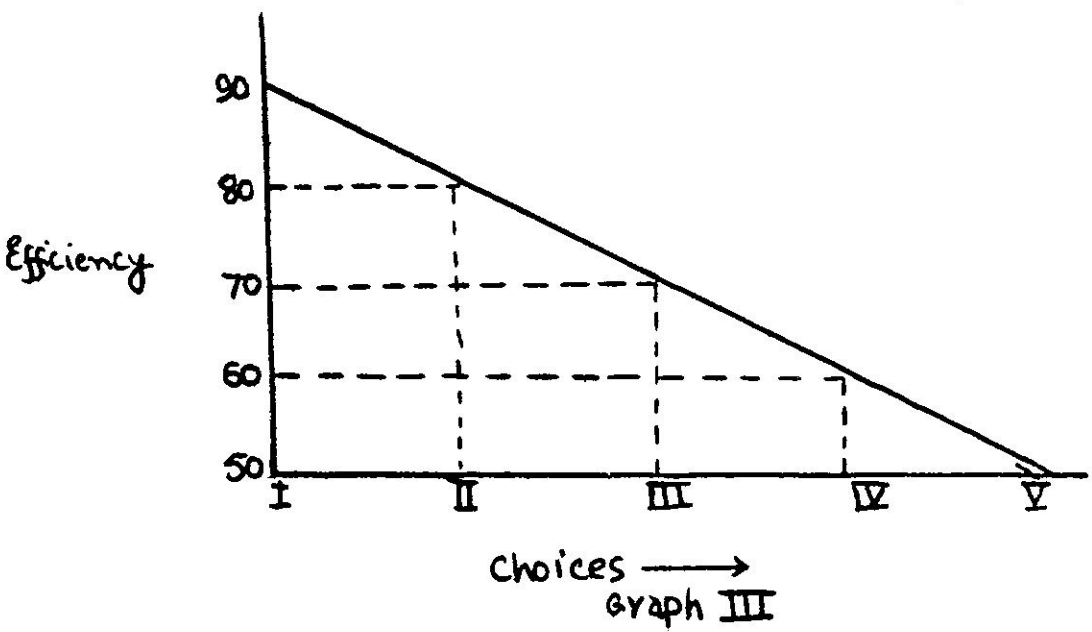
This is so because the urgency of needs can best be appreciated and demands actually realised by 'make' policy. Based on these considerations we fix the high limit of efficiency 90% for Make All and a low limit of 50% for Buy All. The relationship in this case is strictly not co-linear. A curvature as shown in Graph II has been adopted in this case. Efficiency figures, therefore, can be read as under :

Alternative	Normalized figure of Efficiency
1. Make all	90
2. 75% Make, 25% Buy	85
3. 50% Make, 50% Buy	70
4. 25% Make, 75% Buy	55
5. Buy all	50

(c) Efficiency figures, because of effect on factory load, shall also be evaluated and normalized on lines similar to those under (a) and (b) above.

The less the orders for make decision, less shall be the load factor on factory, resulting in spare capacity.

For full Make we therefore place the high limit at 90% and full Buy as 50%. The in-



Graph III

tervening efficiency figures for the remaining alternatives may be read from Graph III.

Alternative	Normalized Efficiency Figures
1. Full Make	90
2. 75% Make, 25% Buy	80
3. 50% Make. 50% Buy	70
4. 25% Make, 75% Buy	60
5. Full Buy	50

The final shape of the matrix for this example will look as under :—

upon how the weights are arrived at. A slight change, say, a price advantage of 0.6 in place of 0.5, would have given a new shape to the matrix. It is true that there are, as in all measurements, including Time Study, subjective elements in the methodology of the decision matrix, particularly in the fixation of weights and the efficiencies of alternatives, yet its great advantage in Production Planning lies in its compulsion to consider all the factors involved in the decision of Make or Buy, in their true and total perspective. The decision so arrived

Weights / Alternatives	Price advantage		Factory Load		Prompt Delivery		Value
	0.5		0.2		0.3		
Make all	50		90		90		70
		25		18		27	
75% Make 25% Buy	60		80		85		71.5
		30		16		25.5	
50% Make 50% Buy	69		70		70		69.5
		34.5		14		21	
25% Make 75% Buy	77		60		55		67
		38.5		12		16.5	
Buy All	90		50		50		70
		45		10		15	

The decision recommended was, as would be obvious from the above, 75% Buy and 25% Make, followed by Make all and Buy all. The decision arrived at would not have been possible but for the evaluation of all the factors through the method adopted above.

Intuitively we would have taken the action for 100% Buy, because of the cheaper rate offered by the outside party. Value analysis has helped us, firstly to consider all the important requirements in detail and secondly to evaluate them to determine the sum total of their effects before any decision could be arrived at.

In the illustration cited above, much depends at is more scientific and rational, at least logically more valid and substantial than a decision based on hunch.

Even the fixation of weights and efficiency figures are, however, in practice, not all that subjective as they seem to be, as the subjectivity gets fairly 'crushed' in Group Discussion. The fixation of these factors is usually entrusted to, as in the case of all Value Analysis problems, to a Task Group. This Group consists of representatives drawn from Purchase, Design, Production and Quality Control. It considers all the available data pertaining to the problem to arrive at the needed figures of Weights and Efficiencies.●●●

"To the person who stole my car : You have my deepest sympathy."

The DARSIRI Method of Value Analysis

Recently the Productivity Centre of the Central Labour Institute (Bombay) have brought out a Manual on what they call the DARSIRI Method of Value Analysis. The name Darsiri, as explained in the text, is only a combination of the initial letters of the seven steps essential in every project of Value Analysis. The name has been apparently adopted to make it appear unique or original. Actually the theory, as presented in the Manual, while excellent in its exposition, simplicity of expression and the extraordinary richness of its illustrations, is practically the same as the one with which Value Engineers are familiar in this country. Really the distinguishing feature of the Manual, apart from the examples referred to, is the series of Case Studies, which enrich the concluding half of the Manual. These have been—the examples and the case studies—reprinted here *in extenso* with the permission of the Central Labour Institute to which the NPC is greatly indebted.[1] In order to present a continuity in analysis, a summary of the significant portions of the theory is given here, followed by examples which are really answers to the series of questions asked in any value analysis procedure; then we have the case studies relating to a number of companies operating in India.

VALUE ANALYSIS IS A TECHNIQUE IN INDUSTRIAL Engineering for performing a detailed analysis of all the elements that contribute to the cost of a product or process. The procedure involves a systematic appraisal of each element by considering alternatives and improvements, in order to obtain an optimum value for the money invested.

A logical plan for reducing costs, or improving qualities is worked out by the coordinated efforts of a group of technicians. The DARSIRI Method is a step-by-step routine which can be followed in order to ensure that the value of the product studied is diagnosed from the points of view of all specialised activities involved.

[1] Courtesy requires that particular mention should be made of the ILO expert, Dr. PR Attwood, who collaborated with the experts of the Central Labour Institute, in working out this Project.

The analysis of a product is impossible until its functions are laid down in a clear-cut way, and each feature has been identified. Function is an important concept; **the objective of value analysis is to decide what a product should do, rather than to improve its production efficiency directly.** A design is the most valuable or cost effective, when it satisfies the designed functional requirements and contributes to more long-term profit than other designs.

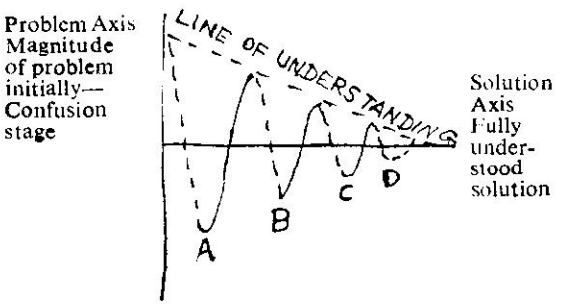
The DARSIRI Method

The need for a systematic approach to any problem is recognised by everyone concerned such as doctors, psychologists, electronic engineers, marketing managers and mathematicians. The DARSIRI Method is a logical routine for solving industrial problems, by identifying functions, evaluating ways of achieving them and recommending solutions that offer the best value. In order to solve a problem, all compo-

nent parts must be investigated; it is impossible to get to the core of an apple without biting into the sides. Problems of value can be solved by developing patterns of thinking and the DARSIRI Method is one based upon a scientific procedure that is particularly suitable for use in industry.

Scientific thinking has four basic stages and these are utilised in the DARSIRI Method. The thinking process for solving problems is illustrated in Figure 1. The stages of scientific thinking are as follows:

1. CONFUSION—the awareness of problems which are causing trouble.
2. ANALYSIS—the resolution of contributing factors.
3. CONSIDERATION—the comparison of possible solutions.
4. VERIFICATION—the confirmation of the optimum solution.



Thinking nodes-ABCD

—Development of ideas. (Theoretical thinking)

—Evaluation into suggestions. (Practical Thinking)

Fig. 1: *The Creative Thinking Process*

The DARSIRI Method is concerned mainly with the "Analysis" and "Consideration" stages, because it assumes that the product contributing to the confusion stage has been selected by the Management authorising the study and they will implement the solution after the verification stage. The DARSIRI Method has seven steps, each denoted by its initial letter to form the word "DARSIRI".

1. DATA COLLECTION—gathering information relevant to the selected product.
2. ANALYSIS—developing new ideas for performing its function.
3. RECORD OF IDEAS—the minutes of the analysis meeting.
4. SPECULATION—converting the ideas into practical suggestions.
5. INVESTIGATION—testing the suggestion in practice.
6. RECOMMENDATION — deciding which suggestion gives the best value.
7. IMPLEMENTATION—installing the recommended solution by management.

(i) THE LADIES HANDBAG CASE

The use of the value equation can be illustrated in the example of a firm manufacturing leather goods. The production of ladies' handbags was causing them concern due to rising cost of fittings, in particular, fasteners for closing the hand-bag. Functionally, the objective of a fastener is to close a handbag securely, whilst its prestige depends upon its attractiveness to users and its financial value is related to its price and grade. Therefore, quality could be defined by terms of reference for the fastener that would include a description of its function; of its finish and appearance; and the cost of the fastener in relation to the selling price of the handbag. Any handbag fastener that complied satisfactorily with these terms of reference would be suitable, but the one costing least would give the best value.

The requirements of the handbag fastener to give the best value would be:

1. It must close a handbag securely.
2. It must be attractive.
3. It must permit competitive selling at an economic price.

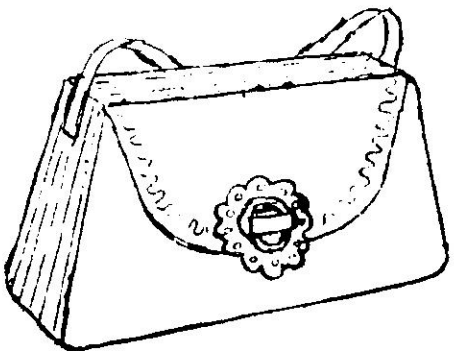


Fig : 2 Ladies' handbag

When the value of a product is related to its cost and to its terms of reference for quality, it is possible to arrive at an objective assessment of value, the best value being obtained when the terms of reference are met with the least cost. The DARSIRI Method of value analysis aims at removing unnecessary costs and qualities; therefore, an ideal product is one that complies with its defined quality and costs the minimum of money.

When analysing the requirements of the handbag with a view to increasing its value, each item of cost should be considered. If the fastener is gold plated and is expensive for its function, alternative materials will have to be considered. An alternative material might be polished brass which would satisfy the terms of reference at a cheaper cost. The Value Ratio which is comparison of costs, would show that a brass fastener costing Rs. 2.85, when compared with a gold fastener costing Rs. 4.10 could be made to exactly the same functional design for almost half the cost.

$$\text{ValueRatio} = \frac{\text{Old Cost}}{\text{New Cost}} = \frac{\text{Rs. } 4.10}{\text{Rs. } 2.85} = \text{Rs. } 1.44$$

The replacement of the gold plated fastener with a polished brass one would retain the same functional utility, yet increase the value by 44%. Prestige is maintained and it is likely to improve the financial value through improved market competition.

(ii) THE SPEEDOMETER PINION

The design department of an automobile manufacturing company provided a description for a speedometer pinion that was developed into terms of reference at a preliminary meeting of senior company officers.

Description: Speedometer Pinion—Part No. 162552

The speedometer pinion is located on the under side of the gear box extension. It takes up the drive from the speedometer gear in the gear box and transmits it through a sleeve to the speedometer cable and then to the speedometer. The sleeve, part No. 162283, is press-fitted on to the pinion shaft and the speedometer cable and is inserted into the square hole in the sleeve. One pinion and one sleeve are required per car.

Terms of Reference for Speedometer Pinion

1. The product shall be a pinion to transmit power from the speedometer gear in the gearbox to the speedometer cable.
2. The pinion shall have dimensions that allow meshing with the speedometer gear, fitting of the speedometer cable and positioning in the gearbox with its bearing, oil seal and retainer.
3. The pinion shall fit with its related parts to prevent oil leakage and to allow free rotation of the pinion and sleeves.
4. The pinion shall have adequate torsional strength to drive the speedometer upto the maximum road speed for the normal car life.
5. The production cost shall be reduced to below Rs. 6.90 per pinion.

(iii) FRUIT SYRUP BOTTLES

The DARSIRI Method was utilised for a project concerning the manufacture of bottles for fruit syrups. Originally, the manufacturing company made its own glass bottles for syrups but the local supply of silica for glass making became exhausted and transporting supplies

from many miles away increased the cost of bottles excessively.

Fig. 3: 750 Ml. Syrup Bottle

Subsequently, the company sought alternative containers or alternative suppliers, at the right price, viz., Rs. 0.50 per bottle. The Plant Manager decided that value analysis should be applied, and called a general meeting of company officers when the problem was discussed and the terms of reference were established.

Terms of reference

1. The container was a bottle for fruit syrups.
2. Its capacity was 750 ml. and its maximum height 25 cm.
3. The bottle should protect and dispense the syrup easily.
4. The bottle should be attractive to customer.
5. It must cost less than Rs. 0.50

Syndicate: The officers appointed to analyse the value of the syrup bottles according to these terms of reference, comprised the company's Cost Accountant, the Purchasing Officer, the Sales Manager, and the Market Research Officer, all acting under the coordination of the bottling Plant Manager.

PROCEDURE

1. **Data Collection:** The members collected data on suitable types of bottle from information in their own departments, from work contacts and from the market in general.

2. **Analysis Meeting:** At the first meeting of the syndicate all the data collected were analysed and the whole bottling process was reviewed in order to create ideas for reducing costs. A summary of the costs for making the current glass bottles was prepared.

Materials:			
Silica for glass	...	Re. 0.177	per bottle
Metal cap	...	Re. 0.065	,, ,,
Machinery:			
Bottle making	...	Re. 0.045	,, ,,
Filling	...	Re. 0.025	,, ,,
Sealing	...	Re. 0.024	,, ,,
Labour:			
Bottle making	...	Re. 0.037	,, ,,
Bottling	...	Re. 0.015	,, ,,
Packing	...	Re. 0.012	,, ,,
Overheads:			
Production charges (@ 3 × labour)	...	Re. 0.192	,, ,,
	Total	Re. 0.592	,, ,,

It was obvious that reducing the total cost from Re. 0.592 to Re. 0.500 could not be obtained from the materials alone; therefore, it was decided to look for suppliers of ready-made bottles. Also, several ideas for alternative bottles were put forward, but the only idea worth considering was a bottle made of plastic.

3. **Record of Ideas:** The cost accountant was chosen as the syndicate secretary and he recorded the minutes of the analysis meeting. He recorded that the present bottle cost of Re. 0.592 was too expensive and that streamlining the production method, looking for an outside source of bottles and manufcturing bottles from plastics should be considered at the speculation meeting.

4. **Speculation Meeting** : At this meeting, members of the syndicate considered different ways of reducing the bottle costs as no appreciable saving could be effected from any improved bottling method and no alternative supplies of bottles were available locally. Plastics could be used as a substitute for glass, whereby the thickness of the bottles would be reduced; and the same glass moulding machinery could be modified for plastic moulding. All this would result in reducing the material cost by about Rs. 0.08 per bottle. This suggestion was worth investigating.

5. **Investigations** : More information was collected on plastic moulding and tests were performed at the plant, using different plastic samples.

Summary of costs for plastic bottles

Material cost	Re. 0.125	per bottle
Metal cap	Re. 0.065	,, ,,
Machinery cost	Re. 0.095	,, ,,
Labour cost	Re. 0.060	,, ,,
Direct overheads	Re. 0.180	,, ,,
Total Cost	Re. 0.525	per bottle

6. **Recommendation Meeting** : The members met to consider the feasibility of the suggestions in order to prepare a recommendation report for management. There was no objection to the use of plastic bottles for syrups from chemical or mechanical view points. The existing machinery could be modified and labour could be trained. It was observed that the charges suggested would not bring down the cost per bottle to Re. 0.50 as laid down in the terms of reference. However, considering that there would be some saving in the transportation cost, resulting from the use of lighter plastic bottle in place of glass bottle, it was thought that this value improvement should be recommended. Also, it was felt that a light-weight bottle would assist sales promotion. The suggestion that a plastic bottle would be more attractive to customers was investigated further by the market research officer. He confirmed that plastic bottles could increase sales marginally by virtue of these properties. Therefore, a recommendation report embodying full details of the method of manufacturing plastic bottles and including cost analysis was presented to the management, recommending that glass bottle should be replaced by a plastic one.

7. **Implementation** : Management accepted the syndicate's recommendation and the purchasing officer was appointed as implementing member. After implementation, it was found that sales increased by 18% and that freight charges were reduced by Re. 0.012 per bottle.

Additional Savings :

Extra profit from increased sales
= Re. 0.064 per bottle
Reduced freight per bottle
= Re. 0.012 ,, ,,
Additional savings = Re. 0.076 per bottle

After marketing syrups in plastic bottles for six months, the actual cost worked out to be Re. 0.449 per bottle and the management was happy with the results.

(iv) THE INSULATED BASE-PLATE

The insulated base-plate of a cut-out unit for three-phase electricity supply was selected as the subject for value analysis project. Initially, the industrial engineering department of the manufacturing company collected the following data:

Base-plate functions:

(i) It insulated all terminals from each other.

(ii) It insulated all terminals from the metal box.

(iii) The operational components were attached to it.

Present Production Method for 100 A. cut-out unit

(i) The base-plate was made from 'Hylam' laminated paper board; size = 84 mm × 164 mm.

(ii) The base-plate was 12 mm. thick.

(iii) The terminals were located on the base-plate as shown in Figure 4.

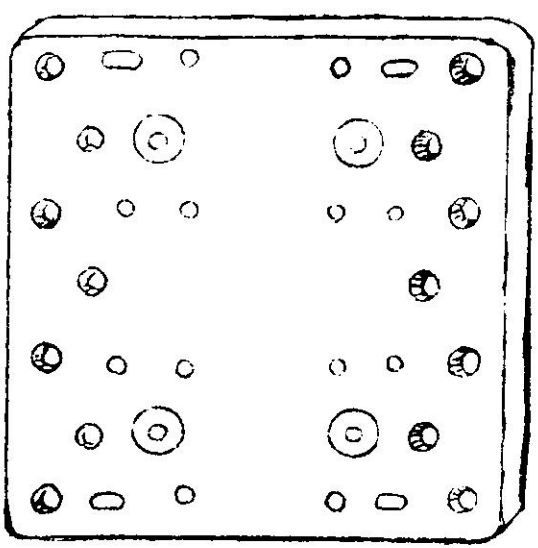


Fig. 4 : 3-phase cut-out baseplate

(iv) the base-plate was cut from 4′×4′ 'Hylam' board with a circular saw; after deburring, the various holes were drilled and counterbored. Then the plates were varnished to prevent moisture absorption which lowered the electrical insulating properties.

Summary of costs for base-plate:

1. Material cost per piece =Rs. 3.34
2. Operational cost per piece =Re. 0.70

Total cost per piece =Rs. 4.04

(v) FRAME MOULDING

Question: What is the functional value of the moulding on a picture frame?

A picture frame encloses a picture card and the piece of glass that protects it. Moulding on a frame has no functional utility, but it will have prestige depending upon the purpose of the picture. If it is intended to decorate the wall of a public room, the moulding can contribute value to the picture frame. However, moulding has no value on a frame hidden in a workshop corner. Therefore, the rating could be A or D, depending on the purpose of the picture.

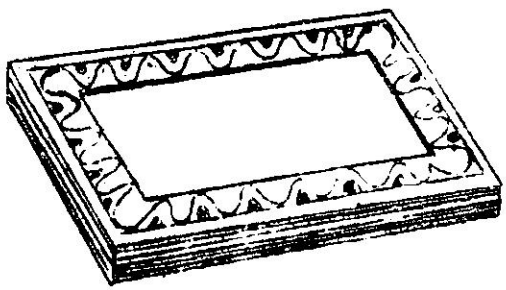


Fig. 5 : A moulded picture frame

(vi) CHROMIUM PLATING

Question: What is the use of chromium plating on a door handle?

To answer this question effectively, it is necessary to identify the purpose of the chromium plating. One purpose is to prevent corrosion, another is to provide a polished surface and another is to provide an attractive appearance. Chromium plating is completely useful only when it satisfies all three purposes, because there are cheaper ways of satisfying each alone. The rating of chromium plating would depend upon the terms of reference; for a door handle it might be B or C, or in some instances, A or D.

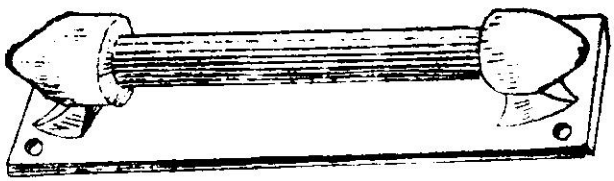


Fig. 6 : Chromium plated handle.

(vii) STRIKING STRIPS

Question: Does a match-box need two striking strips?

Fig. 7 : Match-box

The function of a striking strip is to ignite the matches contained in the match-box, and two strips are necessary only if one strip is inadequate for lighting the full contents of the box. In certain cases, 50 matches can be ignited on one strip, and one match maker dispenses with the other strip. This was alright until the monsoon rains when a single strip became less effective. The answer to this test should be rated according to the terms of reference, but in the example the rating would be B or C.

(viii) GRADED SAND

Question: Is there another use for graded sand?

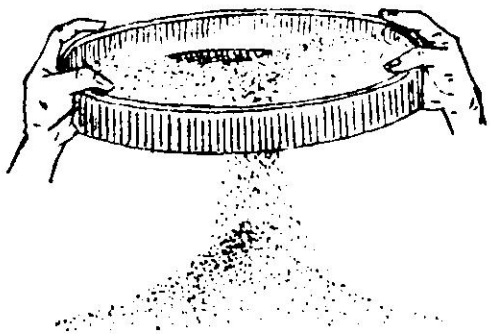


Fig. 8 : Graded Sand

One of the major costs in manufacturing sandpaper is in grading grains of sand according to the different sandpaper grades. This cost can be reduced by distributing it over more items; and salesmen of one company were asked to look for additional sales outlets. One man found another use for graded sand. There was a dust problem in carpentry works, which was created by the use of sandpaper on wood and he had the idea of using sand grains as a more efficient medium for air filtration. It worked satisfactorily when tested. Today, his company sells more graded sand to carpenters for air filters than as sandpaper. The application of this test to the value of graded sand was rated C.

(ix) A DISTANCE PIECE

Question : Is there a cheaper way of making a distance piece?

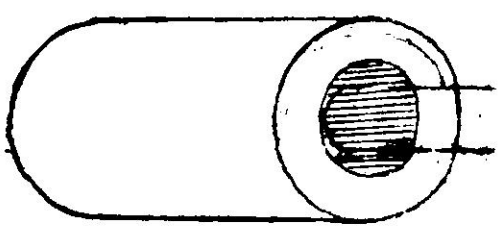


Fig. 9 : Distance Piece

Usually the gear pinions in the gear axle of motor vehicles are spaced apart by a cylindrical tube distance piece, that is fitted over the shaft between them. Such a distance piece was machined from a solid bar by a certain vehicle manufacturer and it had become too expensive for continued production by this method. The function and the cost of the distance piece were identified. Alternative production methods were considered and it was found that casting the distance piece could reduce its cost only by using a cheaper raw material—grey iron instead of mild steel. After applying this test to the distance piece, it was given a rating of B.

(x) THREADING BOLTS

Question: What is the optimum method for threading bolts?

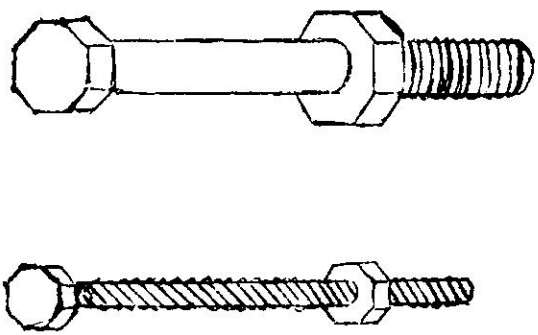


Fig. 10 : Threaded Bolts

A small engineering firm was faced with this question when performing value analysis on the manufacture of bolts. There were two basic methods for cutting screw threads on bolts: either by hand with a hand die; or by using an automatic screw-cutting machine. The first method involved more labour and the second more capital investment. A syndicate analysed comparative costs and found that there was a 'breakeven' production batch size which determined the value of the method selected for threading bolts. This test suggested a rating of C, because there were alternative production methods depending upon the quantity of bolts to be threaded.

(xi) GLASS BOTTLES

Questions : Can standard items be used for making glass bottles?

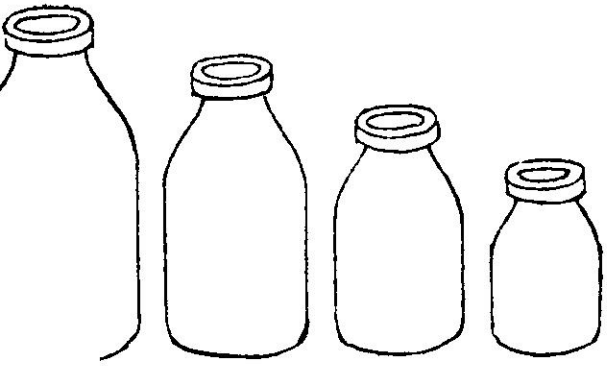


Fig. 11 : Glass Bottles

Glass bottles were being made at a glass works by moulding and the die for moulding them was an expensive item of capital cost; the larger the variety of bottles produced, the wider the range of dies that was required. This glass works improved the value of manufacturing bottles by designing them so that one die for the neck was common to all sizes of bottles, from 5 ml. to 100 ml. capacity. Obviously, a standard cap size was common too and it could be mass produced cheaply. Since an improvement was needed, an alternative design had to be developed and a rating B was given.

(xii) KEROSENE STOVES

Question : How can profit margin affect the value of kerosene stoves?

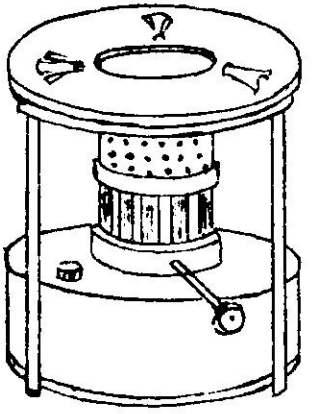


Fig. 12 : Kerosene Stove

Amongst the several makes of kerosene stove available, it was found that of two comparable makes, one was more popular than the other. Value analysis was performed on the less popular stove to improve its sales. It was found that production costs for the two stoves were almost identical, but the selling price of one was much more than that of the other and this accounted for much of the difference in sales volumes. The major difference was found to be in profit margins; in fact, the slow moving stove had a margin of 30% and the fast moving one only 12%: thus this difference meant that the latter required sales for every two of the former to achieve the same capital return. Actually, the sales were in the order of nine to one in favour of the cheaper stove which achieved by far the greater income. This indicated a B rating, because improvements were needed to increase the sales volume.

(xiii) DRAINAGE PIPES

Question: What is the cheapest source of supply for drainage pipes?

Drainage pipes are buried in the ground and carry dirty water usually; therefore, they must be durable, resistant to corrosion and their cost can be reduced because a high quality finish is necessary.

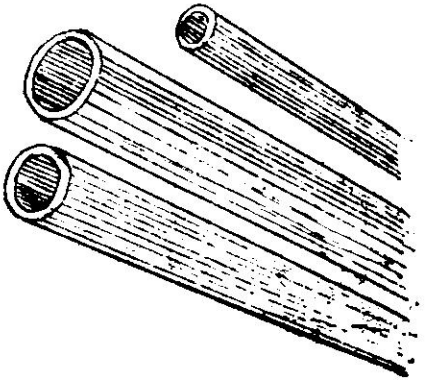


Fig. 13 : Drainage Pipes

In the past, the main sources of supply have been makers of glazed earthenware pipes, but

modern advances in concrete technology allow waterproof cement drainage pipes to compete economically and efficiently. Consequently, makers of cement pipes should be considered as a cheaper source of supply for increasing the value of drainage systems and the answer to this question had a rating C.

(xiv) METALLIC CLOTHING

Question: What is the value of metallic clothing compared with flexible clothing for cotton carding machine?

In cotton mills, traditionally carding machines used flexible card clothing till metallic card clothing was invented.

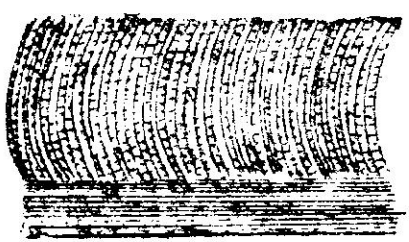


Fig. 14 : Card Clothing

Metallic clothing can be used on automatic machines and the number of machines per operator can be increased, the durability of clothing is improved and the quantity of waste yarn is reduced.

Metallic card clothing can show a 20% saving in the cost of carding cotton and has proved itself to be a valuable alternative. The answer to this test should be rated C.

(xv) MICROMETER

A micrometer frame was the subject of a value analysis project at a tool making company in Bombay. The syndicate had been asked to analyse relevant data with a view to reducing the cost of its manufacture. The current manufacturing process comprised machining the frame from steel bar stock which involved seven milling

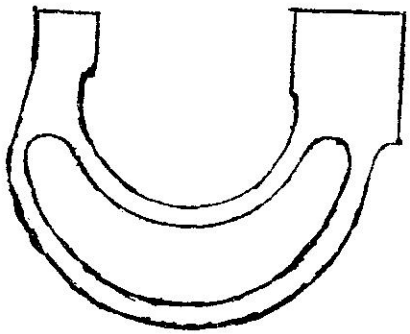


Fig. 15 : Micrometer Frame

operations with a total production cost of 24% of the micrometer selling price. This cost was too high for effective market competition. Alternative manufacturing methods were considered at the analysis stage and further information was gathered to convert the ideas into suggestions at speculation meeting. The alternatives were other supplies of steel stock, modified milling methods, profile cutting and drop-forging the frame.

At the first speculation meeting, the data was considered carefully in conjunction with the analysed ideas for increasing the value of the micrometer frame. An alternative supply for the special steel could save a little cost according to the purchasing officer and a new milling method proposed by the planning engineer would reduce the number of operations to five and the probable cost to 22.4% of the selling price. However, the terms of reference defined the desired production cost to be under 20% of the selling price, and further cost reduction was needed for this purpose.

A proposed method for better utilisation of the steel bar stock involved cutting the shape of the frame with a profile-cutter and then confining the machining to finishing operations only. The production cost for this method was expected to be about 15.0% of the selling price which complied with the terms of reference.

Drop forging seemed very attractive too, especially as there would be virtually no waste of steel (84% was wasted as swarf in the current

method); however, forging needed a high capital outlay on a power-press and dies. After drop-forging, the frame would need only two grinding operations and redesigning the frame would eliminate some material without detracting from the frame strength. The expected direct production costs were about 6.1% of the selling price and naturally, the syndicate members were jubilant after developing this suggestion.

Several speculation meetings were held and the final summary suggested that revising the production method within the terms of reference was possible. Improved milling, profile-cutting and drop-forging should be investigated as possible methods for increasing value. These three methods and their estimated production costs were:

Revised Milling	=	22.4% of selling price
Profile-cutting	=	15.0% ,, ,,
Drop-forging	=	6.1% ,, ,,

All the methods suggested significant saving on the current production cost of 24.0%; only the first method could use existing machines whilst the other two required additional capital outlays which needed investigation.

(xvb) FURTHER INVESTIGATIONS

In the micrometer frame project, three new methods of production were suggested at the speculation stage, but only profile cutting and drop-forging complied with the terms of reference. Therefore, both were suitable for investigating further.

A neighbouring works kindly offered the use of its profile cutter for performing some trial runs and more detailed costing data was obtained. In the case of drop-forging, a manufacturer of power-presses was helpful in supplying costs and a sample micrometer frame.

This new information was prepared for presentation at the next syndicate meeting when a recommendation report was to be prepared.

Recommendation Meeting: When sufficient evidence has been obtained to convert suggestions into definite recommendations, the syndicate should meet to decide which suggestion offers the best value increase. Then a report should be prepared for presentation to management for implementing. An effective way of comparing suggested improvements is in the form of Value Ratios. The one giving the greatest percentage value increase should be recommended in the report, which should include the minutes of the syndicate meetings to show how the recommended improvement was evolved.

(xvc) THE FRAME

The two new methods for manufacturing the micrometer frame that were investigated were profile-cutting and drop-forging. At the recommendation meeting, a Value Ratio was developed for each, comparing each with the original production method. After comparing ratios syndicate members were in a sound position for deciding which new method should be their recommendation for increasing the value of the micrometer.

$$\text{Value Ratio} = \frac{\text{New Value}}{\text{Old Value}} = \frac{\text{Old Cost}}{\text{New Cost}}$$

Profile-cutting: The capital investment in a profile-cutter was Rs. 50,000 with an effective life of 10 years at an annual production volume of 5,000 micrometer frames. Indirect overheads in the form of investment charges and depreciation raised the costs per frame to 16.8% of the micrometer selling price.

Drop-forging: A power-press would cost Rs. 200,000 including special dies that would have a working life 3 years under the circumstances and the indirect everheads boosted the costs per frame to 19.0% of the selling price.

Value Ratios:

$$\text{Profile-cutting} = \frac{24.0}{16.8} = 1.43$$—giving a value increase of 43%.

$$\text{Drop-forging} = \frac{24.0}{19.0} = 1.26$$—giving a value increase of 26%.

The final recommendation to management was that capital should be raised for investing in profile-cutter for making micrometer frames: this would give an expected increase in value of 43%. At the recommendation meeting, the planning engineer was elected as Implementing Member to advise management if it is decided to implement this recommendation.

Implementation: A value analysis syndicate is an advisory body without authority to implement its recommendations, hence it is necessary to prepare a report for presenting to management. The report should outline the steps taken during the proceedings, with explanation and expected results, in order to help management to make its decision. If the report is accepted, the implementing member will be available to ensure that the recommendation is implemeted according to the syndicate's wishes.

(xvd) A PROFILE CUTTER

The management of the tool-manufacturing company accepted the recommendation of its syndicate, i.e. to invest in a profile-cutter for making the micrometer frames. When installed, the savings expected were achieved, with the additional advantages that the profile-cutter could be used for cutting different frame sizes (a drop-forging press would need different dies) and the labour used for removing machining swarf was released for other work.

(xvi) HYPOID PINIONS

The application of the DARSIRI Method of value analysis is well illustrated by the description of a project at a factory manufacturing motor vehicles. The syndicate studied the value of a distance piece for locating the hypoid pinions in the rear axle of an automobile.

INTRODUCTION:

Selected Product: Distance Piece H. 3008165.

Terms of Reference:

The distance piece should:

(1) Maintain the distance between the two tapered-roller bearings of the hypoid pinion in the vehicle rear axle.

(2) Comply with the specifications and drawings for the rear axle layout.

(3) Have a sliding fit on the hypoid pinion shaft.

(4) Resist an axial pressure of 11-13 lbs/sq. inch when tightening the locking nut that holds the bearings in position.

(5) Cost less than Rs. 4.00 to produce.

Syndicate: Five officers of the assembly plant were appointed as members of the syndicate.

PROCEDURE:

1. *Data Collection*: The current material used for the distance piece was imported steel bar of $1\frac{1}{2}$" diameter; each distance piece required a length of 2.54 in. weighing 1.27 lbs. The finished part after machining weighed 0.70 lb., leading to a waste of 55% of valuable imported material.

The work operations were drilling, chamfering, parting, deburring, inspection, degreasing, carburising, hardening, shotblasting and grinding The total work time required was 7.75 minutes per piece and the operations involved eight different machines. The total production cost was Rs. 4.34 per piece and objective of the project was to reduce the production cost to less than Rs. 4.00 whilst complying with the terms of reference.

2. *Analysis Meetings*: The functions of the distance piece were identified by the terms of reference and the syndicate members were surprised at the high waste of steel and the number of work operations required. It was apparent that cost reductions were possible and new ideas were put forth for achieving the functions; for example, tubular material would eliminate waste; local steel would eliminate importation; casting might be possible and a collapsible tube could reduce the time for fitting the distance pieces to the shaft.

3. *Record of ideas*: Four of the ideas were recorded to act as a guide for the members when collecting additional information;

they were: (1) standard tubes, (2) alternative metals, (3) alternative production methods, and (4) collapsible tubes.

4. *Speculation Meetings*: The syndicate members produced more data after the first syndicate meeting and the four ideas recorded were developed into practical suggestions. At later meetings it was suggested that only the idea of using metals other than steel need be discarded (on the question of strength), but alternative steel, produced locally, could be modified to satisfy requirements. Three suggestions were recorded for investigation at this stage and drawings were prepared with specifications and proposed work operations.

5. *Investigation*: The three suggested designs were investigated, i.e., a standard tube, a collapsible tube and a grey-iron casting that complied with the functional requirements and all were proven to be practical. A report on their capabilities and costs was prepared for deciding on the one to be recommended for implementation.

6. *Recommendation*: The three suggestions were found to be practical and all gave worth while cost reductions; therefore, value ratios were calculated for each so that comparisons could be made:

Standard tube: V.R.=1.72
=72% value increase.
Collapsible tube: V.R.=1.44
=44% value increase.
Grey-iron casting: V.R.=1.98
=96% value increase.

(a) It is a productivity raising technique which reduces the direct costs of products and processes studied.

(b) It is an approach to work improvement that makes employees cost-conscious.

(c) It is a team-work technique that prevents over-specialisation and stimulates a wider interest in company activities.

(d) It is a good training ground for the future managers of a company.

(e) It co-ordinates all sections of a company towards the optimum achievement of company policies.

There is little point in assembling a costly team of experts if the savings to be made are small; therefore, it is important to relate the costs of each VA project to the cost reductions that could be achieved. The costs incurred in conducting value analysis are as follows:

(a) Salaries and wages of the full-time staff employed on value analysis.
(b) Administration costs—secretarial and office expenses.
(c) Project costs—toolroom work, test runs etc.
(d) Value of the time served by team specialists.

The savings should be calculated according to the normal procedures used for costing within a company and should include the following items:

(a) Number of projects.
(b) The products and materials studied.
(c) The costs of each study.
(d) The potential savings on each study.
(e) The actual savings on each study.
(f) The ratio of costs to savings for each and all studies.

When capital expenditures are recommended, the usual rates of interest must be applied to them.

Any small reduction in cost should result in an increased profit which is an important reason for being in business; therefore, value analysis is a method for reducing cost and its success is measured by increased profit.

(xvii) ELECTRIC LAMPS

The Brite Electric Lamp Company produce 60 watt lamps which were sold to a wholesale distributor for Rs. 1.20 each. A value analysis study by the company considered reducing the costs of production for lamps and the accountant made a summary of the costs for analysing.

Direct Costs :

Materials = 30 P. for each lamp
Machinery = 15 P. for each lamp
Labour = 20 P. for each lamp

Indirect Costs :

Total for each lamp = 25 P.

Profit Balance :

Income = Costs + Profit
∴ Profit = Income − Costs
= Income − (Direct Costs + Indirect Costs)
= Rs. 1.20 − (0.30 + 0.15 + 0.20 + 0.25)
= Rs. 1.20 − 0.90
= Rs. 0.30 per lamp.

After analysis, the syndicate suggested that the lamp filament-making machine should be modified in order to increase the rate of manufacture. The saving in machine time was estimated at a cost of Rs. 0.05 per lamp.

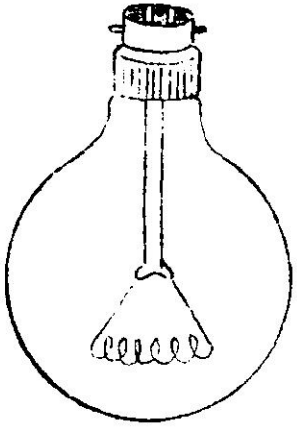


Fig. 16 : Electric Lamp

New Profit = Rs. 1.20 − (0.30 + 0.10 + 0.20 + 0.25)
= Rs. 1.20 − 0.85
= Rs. 0.35.

This may seem a small saving; however, the company made two lakhs electric lamps each year; therefore, the annual savings would be Rs. 10,000.

(a) Value Ratio $= \frac{C_1}{C_2} = \frac{0.90}{0.85} = 1.055.$

(b) Increased Value $= \frac{0.90 - 0.85}{0.85} \times 100\%$
$= \frac{0.05}{0.85} \times 100\%$
$= 5.5\%$

This increased value of 5.5% was considered to be just worthwhile. In this case, a report was submitted to the management recommending a modification to the filament-making machine.

(xviii) PRINTING METAL PLATES

Operators in the Printing Section at the Bombay works of a large engineering company improved the value of preparing metal plates for printing by 350% and it was recognised as a worthwhile contribution to the productivity of India by receiving a Shram Vir National Award.

Paper plates used on rotaprinting machines were capable of producing 2,000 impressions each, but a metal plate could give 20,000 impressions. A new design was recommended whereby an impression from a paper plate could be transferred to a metal plate which resulted in cost reduction. The metal plate obtained by this method was as good as one obtained by normal photographic methods, but was considerably cheaper to produce. The implementation of this recommendation reduced the time for preparing a metal printing plate from fifteen days to one day; also it could be produced without outide help when a rotaprinter was available. The cost of preparing a single plate was reduced from Rs. 49/- to Rs. 14/- with an annual saving of Rs. 6,000 to this company.

Since there was a wide scope for using this simple idea wherever rotaprinters were available, it was an excellent example of using commonsense to raise productivity.

(xix) CLUTCH FOR ELECTRIC MOTOR

An idea originating in the machine shop of an engineering company was converted into a practical recommendation that improved productivity when implemented. The company manufactured milling machines having longitudinal, cross and vertical rapid traverses; the rapid traverse was driven through a gearbox by an

independent electric motor and engaged by a disc clutch. Operating the gear lever depression, the clutch works in conjunction with both the feed and directional levers.

The rotary drive from the rapid traverse gearbox was unsuitable for a sliding movement to engage the clutch; however, a simple device for engaging the clutch with a rotary motion was designed and tested. It proved successful. The modified design simplified the gear shifting mechanism and eliminated a number of components, thereby reducing cost as well improving functional utility. The cost reduction when implemented was Rs. 5,000 per year, and the production cost of this mechanism was halved.

CASE STUDY 1

Radiant Soap Company

Product or Process: **4 Kg. Pack for Radiant Soap Powder.**

Objective: To improve the value of the package for distributing Radiant Soap Powder to customers and retailers.

Terms of Reference

1. The pack must hold 4 Kg. of soap powder.
2. It must withstand mishandling.
3. It should be carried easily.
4. It must protect the contents from damage.
5. It should be attractive to customers.
6. Its cost must be less than 10% of the selling price.

Syndicate Composition

Coordinator	: Works Manager
Secretary	: Industrial Engineer
Specialists	: Sales Manager
	Purchasing Officer
	Packaging Officer

Agenda for the Syndicate

1. To discuss the Terms of Reference;
2. To collect relevant information about the pack;
3. To analyse this information;
4. To record ideas developed and decide what other information was needed;
5. To circulate the record to syndicate members;
6. To speculate on cost reduction after collecting further information;
7. To investigate the suggestions in practice;
8. To evaluate the suggestions;
9. To recommend the best suggestion in a report to management;
10. To assist management if the recommendation is implemented.

1. Data Collected

Present Materials: 3-ply cardboard carton (7.40 % of price)
14″×22″ polythene bag (2.25%)
Rubber band (0.14%)
40″ gummed tape (0.21%)
6 steel staples (0.15%)
2 Radiant labels (0.30%).
Total materials cost = 10.45% of selling price

Production Method: All assembly work operations were manual, involving two men filling bags, one man weighing them, one man transporting the bags and cartons to the packing table and three women packing the cartons whilst another labelled them. The sequence of operations was the following:

1. Making carton and stapling bottom.
2. Filling soap powder into polythene bag.
3. Weighing bag and contents.
4. Closing bag with rubber band.
5. Putting bag into carton.
6. Closing and stapling carton flaps.
7. Sealing carton with gummed tape.
8. Pasting labels on two sides.

Work Contents: The work operations were timed and rated in order to prepare standard times (given as standard man minutes) and percentage costs.

Making carton: 1.12 Sms (0.20% of price)
Filling powder: 3.46 Sms (0.41%)
Closing carton: 0.72 Sms (0.13%)
Labelling : 2.42 Sms (0.33%)
Total Labour cost=1.07% of selling price.

COMBINED COSTS OF MATERIALS AND LABOUR =11.52%

Marketing Information: Details of the packs, weights and prices for Radiant Soap Powder and competitors, in large economy sizes were obtained by the Sales Department.

Radiant : 4 Kg. soap powder in polythene bag and cardboard carton retailing at Rs. 17.10

Sapotex : 3 Kg. soap powder in paper and polythene bags selling at Rs.15.50

Det : 4 Kg. soap powder in polythene bag and tin at a price of Rs. 28.50

Sway : 4½ Kg. soap powder in a tin for Rs. 23.75

Bonus : 3 Kg. soap powder in polythene and paper bags for Rs 16.25

Soap Chips: were available in polythene bags at price of Rs. 4.00 to Rs. 7.00 for 3 Kg.

2. Analysis Syndicate Meeting

The cost of the pack for Radiant Soap Powder had to be reduced from 11.52% to 10.00% of the selling price to comply with the Terms of Reference. The greatest reductions were possible from the materials and not the work operations; alternatives that could be considered included paper and polythene bags or plastic containers and tins. It was essential to protect the soap powder from moisture damage and the pack should be carried easily by women; therefore, suitable containers had to be analysed.

Application was made of the Ten Tests for Value to the present pack:

1. The usefulness of the function was rated A.
2. Costs needed improvement to be proportional to usefulness (rated B).
3. All the features were necessary (rated A).
4. Alternative functions could be performed with improvements to the pack (rated BC).
5. Improvements could make items cheaper (rated B).
6. Some standard items might be used as alternatives (rated C).
7. Production methods could be improved (rated B).
8. The profit margin was included in the Terms of Reference (rated A).
9. There could be other suppliers (rated C).
10. Alternatives were feasible in several areas (rated C).

3. Record of Ideas from the Analysis Meeting

In his record of the Analysis meeting, the Secretary noted down briefly all the items that were considered when analysing the pack, including the cost reduction of 1.52% required and the desirability of its utility as defined. The analysis was performed with the aid of the Ten Tests for Value and rating the answers suggested that the areas for cost reduction would be improvements and alternatives. After circulating this record, the syndicate members collected more information pertinent to the ideas developed.

4. Speculation Syndicate Meeting

It was suggested that the cost of materials could be reduced by eliminating the rubber band, staples, labels and possibly the polythene bag, by combining them into a waterproof carton with gummed flaps and printed sides. The same size of carton should be retained with smaller top flaps and the present card could be changed to 3-ply bitumenised card. The handle should be reduced in size and the carton should be printed with two colours only. Plastic buckets or bags might increase the value of the pack after the soap powder had been used and so would a decorated tin.

5. Investigation of Suggestions

The savings from the suggested changes were expected to be:

Eliminate band staples and bag	=2.76%
Combining operations	=0.61%
Total savings	=3.37%
Cost of revising the carton	=0.27%
Cost reduction expected	=3.10%

The use of plastic container of tins were out of the question on the count of cost, because the value of these containers to customers could not be estimated accurately.

When investigated, other suggestions were unpractical and only the revised waterproof cardboard carton was suitable for recommending to management.

6. Recommendation Syndicate Meeting

The waterproof cardboard carton was recommended for implementing, because it was expected to comply with the Terms of Reference.

Present cost of pack	=11.52%
Expected cost reduction	= 3.10%
Expected cost of pack	= 8.42%

$$\text{Value Ratio} = \frac{\text{Old cost}}{\text{New cost}} = \frac{11.52\%}{8.42\%} = 1.368$$

This figure represented an increase in value over the existing pack amounting to 36.8%.

7. Implementation of Recommendation

The recommendations were presented to the management. The Packaging Officer was chosen as the Implementing Member.●●●

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SPECIALISTS !

"A quarter of a century ago, at the University of California, there were specialists not on economic theory, not on price theory, not on agricultural prices, not on fruit prices but on prune prices and citrus prices. These were not great men but they did useful work and were highly respected by the prune growers and citrus cooperatives. They would have been less useful if exposed to more cosmic questions ....."

— Prof. John Kenneth Galbraith

CASE STUDY 2

Sion Light Engineering Works

Product or Process: **Manufacture of FW5 Fire Extinguisher Caps**

Objective: To improve the profitability of the company by raising productivity when manufacturing FW5 standard fire extinguisher caps.

INTRODUCTION

Background of the company: The company started five years ago with the policy of manufacturing and assembling light engineering products, mainly on contract to larger organizations. At present, the major contract was for manufacturing FW5 fire extinguisher caps which represented almost 80% of the works' total output. The daily output was 80 assembled caps packed ready for despatch. All fire extinguisher components had to comply with the I.S. safety regulations; therefore, functional designs had to be approved before modifications could be incorporated into the product. The personnel comprised 44 skilled and unskilled workers and 8 executive officers.

The value analysis syndicate was coordinated by the Works Manager and other members were the Chief Desinger, the Cost Accountant, the Industrial Engineer and the Sales Superintendent. At the end of the last financial year, the company had lost Rs. 10.000/- from manufacturing FW5 caps and this was the reason for the value analysis project. Value could be increased only by reducing manufacturing costs: wages of workers could not be decreased without causing Union troubles and the cost of materials was fixed: therefore, savings would have to come from improved production methods. Bulk purchasing was cheaper, but the company had inadequate storage facilities; also it was considered wrong to reduce the executives' salaries, because this would encourage them to seek employment elsewhere.

Objective of the Syndicate: Value had to be increased by reducing manufacturing costs because the shareholders were demanding a profit this year. Profit was the difference between income and expenditure, but the works' income was fixed by the FW5 contract; therefore, reducing expenditure was the obvious solution. Expenditure comprised both direct and indirect costs and reducing the former was chosen as the prime objective for the syndicate.

Terms of Reference

At a general meeting of the company, Terms of Reference for the FW5 fire extinguisher cap were prepared to define its utility.

1. The FW5 cap protected the striking knob of standard fire extinguishers.
2. It must comply with specifications IS 933/4 for types of material and technical design.
3. It was an essential component of fire extinguishers; although they were rarely used, full functional effectiveness was vital for safety.
4. The cap had no prestige utility apart from good quality workmanship.
5. Manufacturing costs had to be reduced

in order to abrogate a financial loss of Rs. 10,000/- last year and to make a profit this year.

Agenda for the Syndicate

1. To discuss the Terms of Reference.
2. To collect manufacturing data for the FW5 cap.
3. To analyse the data collected.
4. To record minutes of the analysis meeting.
5. To collect other data in order to substantiate new ideas.
6. To speculate on practical cost reductions.
7. To investigate the effectiveness of the suggestions speculated.
8. To evaluate the suggestions investigated.
9. To report recommendations for increasing the value of manufacturing FW5 caps.
10. To appoint an implementing member.

PROCEDURE

The syndicate adopted the DARSIRI Method of Value Analysis for improving the profitability of the FW5 fire extinguisher cap by reducing manufacturing costs.

1. Data collected

Design: The technical drawing of an FW5 cap was made available giving dimensions and components.

Material:

Gun metal	Rs. 13.75 per kg.
Brass	Rs. 9.60 per kg.
Asbestos string	Re. 0.01 per cap.
Rubber sealing washer	Re. 0.04 each.

Production Method: A layout of the workplace that included machine locations and flow-lines was prepared. Details of the components of FW5 caps and the work operations involved were also prepared.

Standard work times: Activity Sampling was performed before studying the individual work times and it was found that no machine or operator was utilised for more than 50% of the available work time. The following rest allowances were made when compiling the standard times:

Personal allowance	= 5%
Basic fatigue allowance	= 4%
Standing allowance	= 2%
Working condition allowance	= 5%
Total	=16%

NB: Allowances varied according to the nature of work operation.

Process Times: In a similar way, the standard work times were clasified according to the processes per piece:

1.	Casting	6.82 Standard man minutes
2.	Machining	26.61 sms.
3.	Buffing	6.45 sms.
4.	Testing	0.96 sms.
5.	Assembly	10.93 sms.
6.	Inspecting	2.17 sms.
7.	Transporting	0.91 sms.
8.	Packing	0.90 sms.
	Total	55.75 sms.

Machinery: None of the machines were operated at the makers' recommended speeds, but their maintenance was good. There was excessive swarf when parting the hexagonal brass bar with a cutting tool 1/8" wide in order to make the packing nut. The machinery costs per hour

Standard Work Times For FW5 Cap

Op. No.	Operation description	Batch Size	Time Mins.	Distance feet	Minutes per piece	
					Skilled	Unskilled
	CAP BODY					
A1	Gun metal ingots in store	—	—	—	—	—
A2	Transport to Foundry	100	7.80	40	—	0.08
A3	Casting cap body	10	29.85	—	3.00	—
A4	Transport to machine shop L_1	100	5.55	30	—	0.06
A5	Machining inner face of L_1	1	2.85	—	2.85	—
A6	Transport to L_2	8	0.35	10	—	0.04
A7	Cutting inner thread on L_2	1	3.74	—	3.74	—
A8	Transport to L_3	10	0.35	10	—	0.04
A9	Drilling boss and tapping tread on L_3	1	1.84	—	1.84	—
A10	Transport to tester	100	4.58	30	—	0.05
A11	Pressure testing (4% rejection)	4	3.83	—	0.96	—
A12	Transport to buffer	100	2.86	10	—	0.03
A13	Buffing outer surfaces	1	4.15	—	4.15	—
A14	Transport to Assembly shops	100	3.58	20	—	0.04
	NECK RING					
B1	Gun metal ingots in store	—	—	—	—	—
B2	Transport to foundry	100	3.99	40	—	0.04
B3	Casting neck ring	10	21.37	—	2.14	—
B4	Transport to machine shop L_1	100	5.39	30	—	0.05
B5	Machining face and flange on L_1	1	3.60	—	3.60	—
B6	Transport to L_2	10	0.34	10	—	0.03
B7	Cutting outer thread on L_2	1	3.77	—	3.37	—
B8	Transport to assembly shop	100	4.45	35	—	0.04

Op. No.	Operation description	Batch Size	Time Mins.	Distance Feet	Minutes per piece	
					Skilled	Unskilled
	SPINDLE					
C1	Gun metal ingots in foundry	—	—	—	—	—
C2	Casting Spindle	20	21.38	—	1.07	—
C3	Transport to machine shop (L_2)	100	7.95	50	—	0.08
C4	Cutting lower thread on (L_2)	1	2.02	—	2.02	—
C5	Transport to buffer	100	3.34	15	—	0.03
C6	Buffing Spindle	1	2.30	—	2.30	—
C7	Transport to assembly shop	100	3.61	20	—	0.04
	BUTTON					
D1	Gun metal ingots in foundry	—	—	—	—	—
D2	Casting button	20	12.19	—	0.61	—
D3	Transport to machine shop (L_1)	100	4.44	40	—	0.04
D4	Cutting thread and face on (L_4)	1	3.46	—	3.46	—
D5	Transport to assembly shop	100	5.33	50	—	0.05
	PACKING NUT					
E1	Brass bar in store	—	—	—	—	—
E2	Transport to machine shop (L_4)	100	5.40	60	—	0.05
E3	Cut bar for packing nuts on L_4	1	2.84	—	2.84	—
E4	Transport to L_3	100	3.38	20	—	0.03
E5	Drilling and cutting thread L_3	1	2.49	—	2.49	—
	PACKING AND WASHER					
F1	Washers and asbestos string in store	—	—	—	—	—
F2	Transport to assembly shop	100	4.61	40	—	0.05

Op. No.	Operation description	Batch Size	Time Mins.	Distance feet	Minutes per piece	
					Skilled	Unskilled
	ASSEMBLY					
G1	Components in assembly shop	—	—	—	—	—
G2	Obtaining cap body	1	0.09	—	0.09	—
G3	Obtaining spindle and fitting nut	1	2.01	—	2.01	—
G4	Winding string around spindle	1	0.65	—	0.65	—
G5	Inserting spindle through boss	1	0.56	—	0.56	—
G6	Cutting string	1	0.39	—	0.39	—
G7	Fitting nut into boss	1	2.00	—	2.00	—
G8	Tightening nut with spanner	1	0.60	—	0.60	—
G9	Fitting button to spindle	1	1.26	—	1.26	—
G10	Fitting washer	1	0.35	—	0.35	—
G11	Joining cap body and neck ring	1	3.02	—	3.02	—
G12	Inspecting assembled cap	1	2.17	—	2.17	—
G13	Putting cap into box for despatch	1	0.90	—	0.90	—
	Total Standard Work Time		=	54.84	0.91	
	Standard Manufacturing Time		=	55.75		

The total work times inolving the classified elements were calculated per piece as in the Table below.

Summary of Standard Work Times

Operations	Total Transport Distances (ft.)	Work Times (mins.)	
		Skilled	Unskilled
A. Cap body	150	16.54	0.34
B. Neck ring	115	9.51	0.16
C. Spindle	85	5.39	0.15
D. Button	90	4.07	0.09
E. Packing Nut	120	5.33	0.12
F. Packing and washer	40	—	0.05
G. Assembly	—	14.00	—
All Operations	600	54.84	0.91

were:

Casting	....Rs. 1.50
Machining	....Rs. 2.00
Buffing	....Rs. 1.00
Testing	....Re. 0.50

Labour: Direct labour for manufacturing was of two kinds; (1) skilled operators for casting, machining, testing, inspecting and assembling; (2) unskilled labour for transporting around the works. Direct labour for supervision, administration, maintenance and general work was included with the direct overheads for the purpose of costing. The direct labour costs were:

Skilled operators	....Rs. 2.00 per hour
Unskilled labour	....Rs. 1.10 per hour

Overheads: Direct overhead costs were as follows:

Supervision and administration	..Rs. 31,000 p.a.
Power, lighting and services	..Rs. 5,000 p.a.
Total	..Rs. 36,000 p.a.

Profit: Although a fair profit was desirable, the company had made a net loss of Rs. 10,000/- in the previous year and it was hoped to rectify this position by applying value analysis. A fair profit margin was considered to be 20% of turnover, i.e. 10% for dividend to shareholders and 10% for company reserves to be used for development purposes.

Production: The annual production volume was 24,000 FW5 fire extinguisher caps, but careful planning and reorganization of the work to utilise the labour force more efficiently could double this volume.

Production costs: The direct costs per piece manufactured were high in relation to the selling price and a net loss resulted last year.

Material Costs

1310 grams gun metal @ Rs. 13.75 per kg.	=Rs. 18.05 per piece.
40 grams brass @ Rs.9.00 per kg.	=Re. 0.35 ,, ,,
Asbestos string	=Re. 0.01 ,, ,,
Rubber washer	=Re. 0.04 ,, ,,
Total	Rs. 18.45 per piece

Labour Costs

Skilled labour cost=54.75 sms × Rs. 2.00/60
= Rs. 1.83 per piece

Unskilled labour cost=0.91 sms × Rs. 1.10/60
= Re. 0.02 per piece

Total=Rs. 1.85 per piece

Machinery Costs

Casting—6.82 sms × Rs. 1.50/60
=Re. 0.17 per piece

Machining—26.61 sms × Rs. 2.00/60=Re.0.89 ,,

Buffing—6.45 sms × Rs. 1.00/60=Re.0.11 ,,

Testing—0.96 sms × Re. 0.50/60=Re.0.01 ,,

Total =Rs. 1 18

Direct overheads: The direct overheads incurred for the works' production last year was Rs. 36,000 and 80% of the production was 24,000 FW5 caps. Therefore direct overheads per cap were:

$$\text{Rs. } \frac{36{,}000}{24{,}000} \times \frac{80}{100} = \text{Rs. } 1.20 \text{ per piece}$$

Total Production Costs=Rs. 18.45+1.85+1.18 +1.20=Rs. 22.68 per piece

General expenses: Expenses included general services, marketing, discounts, rent, taxes and interest; deducting them from the gross profit gave a net loss of Rs. 10,000/- for the company last year.

Selling price—Production costs = Gross Profit

Gross Profit—General expenses = Net profit or loss

GROSS PROFIT = Rs. 25.80—Rs. 22.68
= Rs. 3.12 per piece

GENERAL EXPENSES = Rs. 3.12 + Re. 0.42
= Rs. 3.54

NET LOSS = Rs. $\frac{10,000}{24,000}$ = Re. 0.42 per piece

Marketing: Last year's production volume of 24,000 FW5 fire extinguisher caps was sold quite easily and sales could be increased in future to between 45,000 and 50.000 caps per annum. The FW5 cap was standard for industrial fire extinguishers and other manufacturers of extinguishers were potential customers. The present price of Rs. 25.80 was competitive and additional orders could be expected for any increased production output at the same price.

Present customer: Fyrfo Private, Ltd., Bombay

Annual requirement = 24,000 caps @ Rs. 25.80

Potential customers:

(1) Veejay Private Ltd., Bombay
Annual consumption = 10,000 caps @ Rs.26.50

(2) Minimax Ltd., Bombay.
Annual requirement = 10,000 caps

(3) Pyrene Rai Ltd., Thana
Annual consumption = 2,000 caps @ Rs.26.50

(4) Zenith Ltd., Ahmedabad
Annual requirement = 5,000 caps.

2. Analysis Meeting

A syndicate meeting was convened after the data had been collected in order to discuss the problem of improving the value of manufacturing FW5 fire extinguisher caps according to specifications. Each member obtained a complete summary of data as presented above and ideas for improving value were developed by questioning the value of the complete product using the Ten Tests for Value.

1. The FW5 cap contributed value because the I.S.I. specified that approved fire extinguishers must be fitted with protective caps. Rating = A.

2. It was felt that costs were not proportional to usefulness. The design and types of material had to remain the same, but the production costs must be reduced. Rating = BC

3. All features were not necessary; for example, the lugs could be removed without detracting from the function of the cap. Rating = B

4. No other function could be performed. Rating = A

5. It was likely that certain elements could be made cheaper with improvements and each was questioned individually at this stage. Rating = B

CAP BODY: The lugs were unnecessary and cheaper non-corrosive materials might be available.

CAP NECK RING: The flange seemed to be thicker than necessary.

SPINDLE: It was probable that standard round bar could be used instead of casting it in gun metal.

PACKING: A closely machined finish to the spindle and the hole through the cap body might eliminate the packing nut that sealed the escape of foam when the extinguisher was in use.

6. The production method seemed to be correct for the present manufacturing procedure, but more care and better organization was needed to increase the efficiency of the men and machines. Obviously management training was required and this value analysis project would be helpful in widening the executives' outlook. Rating = B.

7. It was unlikely that standard items could be used anywhere. Rating = A.

8. There was no profit margin at all and the shareholders were complaining. In order to obtain a fair profit margin of 20%, the production costs would have to be reduced from Rs. 22.68 to Rs. 20.50 approximately. Materials represented 80% of the production costs and it would be appropriate to start reducing costs here: alternatives could be used only if they complied with specifications, but improved designs and production methods should reduce material wastage. Rating=BC.

9. Some items can be obtained at lower cost. Rating=C.

10. Alternatives should be considered for increasing the value of FW5 caps, particularly materials like coated or specially treated mild steel castings or aluminium. Rating=C.

Summarising the ratings given to the Ten Tests for Value showed that greatest value increase appeared to be obtainable from improvement of production methods and better utilization of materials and manpower. Half the tests indicatee that no value increases were possible there were no ratings of D, but a majority of B ratings.

3. Record of Ideas

As Secretary, the industrial engineer was responsible for the summary of proceedings at the analysis syndicate meeting.

4. SPECULATION MEETINGS

Three meetings of the syndicate were held at which the members speculated on the ideas developed at the analysis meeting with a view to considering their practical applications.

A summary of the suggestions which were considered worth investigating is as follows :

CAP BODY: This was cast from expensive gun metal and reducing its weight would save money. The lugs were used for tightening the cap and it was suggested that they be removed. Making a hexagonal boss would allow the cap to be tightened with a spanner and it would require only a modification to the mould used for casting.

NECK RING: reducing the flange thickness by 1 mm. would effect a saving without detracting from its strength. Also, casting from mild steel and lining with lead should be submitted to the I.S.I. for approval; since the fire extinguisher cylinder was made from steel it would enable the neck ring to be welded to it easily.

SPINDLE: this should be made from gun metal bar and the knob made from cast iron for a pressed fit on the spindle.

PLASTIC MATERIALS: it was suggested that the use of polythene and other suitable plastics be investigated.

TEST MARKET SURVEY: Increasing sales could reduce costs slightly and it was suggested that the market potential be investigated.

5. Investigation of Suggestions

The syndicate members individually investigated the suggestions for increasing the value of FW5 fire extinguisher caps, collecting data and I.S.I. approvals. The evaluation of these suggestions was performed at the recommendation syndicate meeting.

6. Recommendation Meeting

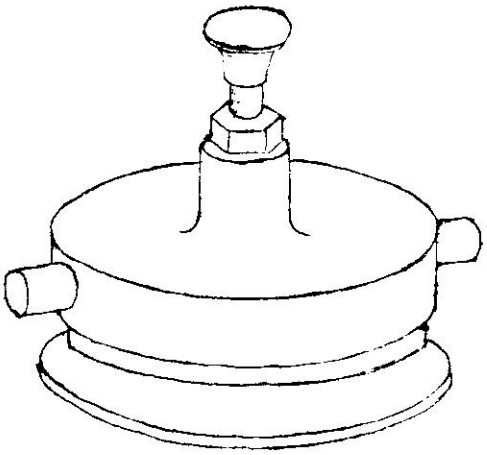
Costs were determined for the modified FW5 cap excluding any designs that did not comply with the terms of reference.

REDESIGNED CAP BODY: Removing the lugs and reducing the boss-size would save 150 grams of gun metal, reduce the buffing and machining time and give a financial saving of Rs. 2.35.

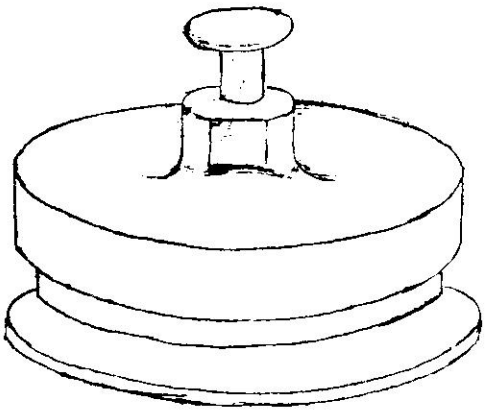
REDESIGNED NECK RING: Reducing the flange thickness saved77 grams of gun metal amounting to Rs. 1.05; cutting fewer threads saved 2.60 sms and Re. 0.15; substituting for mild steel gun metal and lining with lead saved Rs. 1.52.

PACKTNG NUT: Reducing its size saved 20 grams of brass worth Re. 0.20 and eliminated 2.25 sms

FIRE EXTINGUISHER CAP



old design



improved design

of machining time worth Re. 0.13. The combined saving was Re. 0.33.

SPINDLE AND BUTTON: The function of the button was to break the glass bottle of acid inside the fire extinguisher cyclinder. This could be performed quite effectively by the spindle alone. A split pin would prevent the spindle from being extracted. Other savings were availale from reduced machining and buffing time, as well as less material. The combined saving on this component was Re. 1.06.

Total savings: All the modifications above were acceptable and the total savings expected were Rs. 5.94.

Cap body	..	Rs. 2.35	per piece.
Neck ring	..	Rs. 1.20	,, ,,
Packing nut	..	Re. 0.33	,, ,,
Spindle	..	Rs. 1.06	,, ,,
		Rs. 5.94	

VALUE RATIO:

$$\frac{\text{Old cost}}{\text{New Cost}} = \text{Value Ratio} = \frac{\text{Rs.}22.68}{22.68-5.94} = \text{Rs. } 1.353$$

It was decided that the recommended value improvements for the FW5 cap should be:

CAP BODY: Cast in gun metal without lugs and with a smaller, hexagonal boss.

NECK RING: Cast in gun metal with a flange thickness of 4 mm. and one thread less.

PACKING NUT: $\frac{1}{2}$" brass hexagonal nut to replace the $\frac{3}{4}$" nut.

SPINDLE: made from gun metal with a split pin replacing the button.

INCREASED SALES: Finally, it was recommended that efforts should be made to increase the annual sales of FW5 caps, because the test market survey showed that there was a market potential for an additional 25% FW5 caps during the next five years.

7. Implementation

The recommendations of the syndicate were implemented and the savings expected were realised. The cost accountant assisted in implementing the recommendations and he prepared

a value balance sheet.

In the subsequent year the production volume was increased to 29,800 FW5 caps the production cost being Rs. 16.75 and the general expenses Rs. 3.50 per piece. Consequently, the annual net profit was Rs. 25.80—(Rs. 16.75+ Rs. 3.50) × 29,800 = Rs. 1,68,500/-

The net profit represented a 33% return on expenditure and it was responsible for rescuing the company from imminent bankruptcy. The objective of this value analysis project was achieved successfully.

Savings per piece		Expenses per piece	
Production savings	Rs. 5.90	Syndicate expenses	Rs. 0.08
Previous net loss	Rs. 0.42	Rs. 1960/- / 24,000	Rs. 0.08
		Production revision Rs. 3150/- / 24,000	Rs. 0.13
		Tooling costs Rs. 5600/- / 24,000	Rs. 0.24
		General expense Rs. 8400/- / 24,000	Rs. 0.35
		Total expenses	Rs. 0.35
Total savings	Rs. 6.32		Rs. 0.80
Final value saving =	Rs. 5.52 per FWs. cap.		

Not in India, but in America

".....the American Medical Association (AMA) held its annual convention in New York City. There was, it seems, a ceremonial half-hour, dedicated to a devotion to the Flag. But after this piece of jingoism (and they had a right of it—after all they'd put enough of their very own money into the national coffers) after this the trouble started.

A group of young doctors, nurses, medical students, ran forward and on to the platform. They shouted out their belief that the AMA stood not for 'American Medical Association', but for American Murder Association'. There were other cries. 'You're the criminals, who rather than support a preventive health programme have prevented health programmes.' There was more for a few minutes, whilst outraged delegates from the floor flung ash-trays at the insurgents, and one orthodox member, is reported, screamed out: 'Kill the blackguards.'* So all is not well in that land of free and glorious enterprise.

* The original word is a little smutty : so we have changed it to 'blackguards'—**Editor**

STUDY NO. 3

The Herbal Tablet Company

INTRODUCTION

Objective: To improve the value of the packing case for distributing Herbal Tablets in glass jars by reducing the packing cost without impairing its function.

Terms of Reference

i. The packing case should contain 15 cm. tall-jars in multiples of one dozen.

ii. The packing case should resist damage in transit and keep the breakage of jars to a minimum.

iii. The packing case should have a weight of less than 8 kg. including 24 jars.

iv. The contents and destination of the packing case should be shown clearly.

v. The total packings cost should be less than 5% of the selling price of the contents.

PROCEDURE

Preliminary Meeting

At the preliminary meeting of company executives, a Value Analysis syndicate was formed to improve the value of the packing case for tablet jars. A syndicate coordinator and secretary were selected. Data concerning the existing packing case was collected.

The procedure adopted was the DARSIRI Method of Value Analysis.

1. Data Collected

Contents of present wooden packing case	=24 jars
Weight of packing case & contents	=12 Kg.
Selling price of contents (24 jars)	=Rs. 120/-
Total cost of packing	=7.6% of selling price
Annual production	=10,00,000 jars
Method of distribution	=Road and rail.

COMPONENT COSTS:

Materials: Wooden case	=7.20%
Straw	=0.01%
Paper liners	=0.01%
Nails	=0.01%
Steel straps	=0.04%
Labour for packing	=0.33%
	7.60%

METHOD OF PACKING:

Manufacturing Section: Tablets were filled into jars and sealed with screw caps on a conveyor belt. At the end of theconveyor, the jars were packed into specially fabricated wooden cases. Each case held 24 jars and had a top cover.

Packing Section : The wooden cases with cover were transported on a flat truck from the manufacturing section — 10 cases at a time. A layer of straw was placed over the jars and then the cover was nailed in place. Finally two steel straps were fitted around each case. The total time to pack one case was $3\frac{1}{2}$ minutes.

Despatch Section : The cases were loaded on a truck and transported to the loading area.

2. Analysis

The data was analysed by the syndicates of five members on 28th June 1968. The syndicate chose a co-ordinator and a secretary before considering the problem in order to develop ideas for increasing the value of the packing according to the Terms and Reference.

3. Record of Ideas

The secretary of the syndicate presented the ideas considered by the members during the Analysis period.

Ideas created :

a) A reduction in size of the packing case was considered—from two dozen jars capacity to one dozen. A 5-ply paper carton was suggested with collapsible cardboard separators for the glass jars. The conents of the carton and the manufacturer's name could be printed on the outside with a space for the consignee's name and address.

b) Replacing the wooden packing case with a 3-ply cardboard carton was considered, as it would reduce the total weight by about 3 kg. The internal partitions could be replaced by interlocking card separators in order to reduce the weight by a further 1 kg. The materials would be cheaper and less labour would be required for packing.

c) Reducing the contents of a packing case to 12 jars was considered further and the dimensions for a case with a minimum surface area was calculated. Protection of the jars could be provided with straw ropes instead of wooden slats and the steel straps could be replaced by wires if acceptable to the Railways. Each crate could have a handle and a side-opening flap, whilst printed labels could show contents, destination and give notice of glass and the need for careful handling. A work flow diagram was prepared and it was estimated that there would be a 25% saving in labour.

d) Four alternative packings were suggested:
   i. Five ply corrugated paper carton
   ii. Three ply corrugated paper carton
   iii. Improved wooden crate
   iv. Five method ply corrugated paper carton for 24 jars.

There were advantages to each method and all should be investigated to determine actual savings possible, along with reduced contents. Plastic jars were mentioned, but this was outside the Terms of Reference.

4. Speculation and Investigation

The syndicate Members made further enquiries in order to substantiate their ideas for improving the value of packing the jars and this information was considered at Speculation Syndicate Meetings.

a) Enquiries proved that cost savings could be implemented by packing the jars in a cardboard carton. A 5-ply corrugated card carton was suggested for one dozen jars, with an opening lid. Collapsible card separators could be made in two parts and paper liners used above and below the jars for additional protection. The empty packing cases could be stored in folded condition to reduce storage space. The cartons could be printed with manufacturer's name, contents, "This way up" and "Glass with care"; the destination could be stencilled. The lid could be sealed by "Bostitching" and the flaps stapled for safety.

Expected packing costs:

2 cartons for 24 jars	=4.00%
Straw ..	=0.01%
Paper liners ..	=0.01%
Stapling ..	=0.01%
Labour content	=0.20%
Total ..	=4.23%

$$\text{Value Ratio} = \frac{\text{Old cost}}{\text{New cost}} = \frac{7.60\%}{4.23\%} = 1.80$$

b) Direct savings could be obtained by packing jars in 3-ply cardboard cartons with cardboard separators. There would be no need for paper wrappings for individual jars, but steel straps were necessary for rail transportation. The weight for packing two dozen jars would be reduced from 12 kg. to less than 8 kg. The suggested carton size was 20" × 12" × 8" and the expected costs were:

Carton for 24 jars	=4.50%
Packing materials	=0.05%
Labour content	=0.22%
Total	=4.77%

$$\text{Value Ratio} = \frac{7.60}{4.77} = 1.59\%$$

Indirect savings would be available due to lower freight charges, less storage space and less handling of empty cartons and packing materials.

c) It was suggested that the wooden construction of packing cases should be retained, but an open lattice design would reduce its weight for the same thickness of wood. For more convenient handling and added strength each crate, of size 18 cm. × 18cm. × 24 cm, should hold one dozen jars. Wire could replace the steel straps and paper labels could be pasted on the outside of the crates; straw ropes would give internal protection and expected costs were:

2 Wooden crates for 24 jars ..	=3.94%
Straw ropes ..	=0.02%
Nails ..	=0.02%
Wire straps ..	=0.03%
Labour content ...	=0.55%
Total	=4.56%

$$\text{Value Ratio} = \frac{7.60\%}{4.56\%} = 1.67\%$$

4. A 5-ply cardbord carton was suggested for two dozen jars in order to obtain the required cost and weight reductions. Cardboard separators could be used and the carton flaps could be stapled to give adequate strength. The labour should be halved and the expected costs were:

5-ply carton for 24 jars	=3.75%
Straw and paper protection	=0.02%
Staples	=0.02%
Labour content	=0.17%
Total	=3.96%

$$\text{Value Ratio} = \frac{7.60\%}{3.96\%} = 1.92\%$$

5. Recommendation and Implementation

There were some similarities between the value ratios and the packing improvements recommended was a composite one. The company adopted 5-ply cardboard cartons to contain one dozen jars each and the actual costs were:

2 cartons for 24 jars including packing materials	=4.42%
Labour content	=0.50%
Total	=4.92%

$$\text{Actual value ratio} = \frac{7.60}{4.92} = 1.54$$

Indirect savings were 1.00% (largely due to a reduction in freight charge) and the annual cost saving on a production of 10 lakhs jars was Rs. 1.6 lakhs. The syndicate thought that annual sales might drop if the packs contained 12 jars instead of 24, but there was no evidence to support this opinion. ●●●

STUDY NO. 4

Electric Regulator Company

Product or Process: **Fan Regulator**

INTRODUCTION

1. *Objective*: to improve the value of the regulator by cost production.
2. *Preliminary Meeting*: the objective and procedure for analysing the subject were discussed at a general meeting of senior officers of the company.
3. *Terms of Reference*:
   (i) The regulator must control the speed of a 60 watt. fan unit.
   (ii) It must be safe in operation.
   (iii) It must be maintained easily.
   (iv) It must be durable.
   (v) It should have a pleasing appearance.
   (vi) It must cost less than Rs. 9.50 to produce.
4. *Syndicate*: Officers from the company chosen for improving the value of the fan regulator were:

   Co-ordinator: Production Manager
   Secretary: Industrial Engineer
   Members: Cost Accountant,
   Designer,
   Purchasing Officer,
   Marketing Manager.

PROCEDURE

1. **Data Collection**
   The data for analysis was collected by the company officers elected to the Syndicate who collected information about the functions and the costs of the fan regulator components.

Functions of Components with Costs :

The costs included all the direct costs of materials, machinery, manpower and overheads.

BAKELITE COVER: Cost of Rs. 2.50; its function was to protect the user from accidental contact with the live components and to prevent the entry of dust.

METAL BASEPLATE: cost Re. 0.75; its function was to carry the regulator assembly.

PORCELAIN INSULATOR: cost Re. 0.20; its function was to insulate the resistance wire and withstand heat generated.

RESISTANCE WIRE: cost Re. 1.05; its function was to change the resistance of the electrical circuit to the fan unit (at present it provided six fan speeds).

LAMINATE PLATE: cost Re. 0.58; it functioned as a plate to carry the speed control regulator components.

EIGHT CONTACT POINTS: cost Re. 0.84; they

served to connect the fan electrical circuit to the six different resistance wire tappings.

CONTACT SEGMENT: cost Re. 0.51; it completed the electrical circuit for the different contact points.

TWO TERMINALS: cost Re. 0.25; their function was to connect the regulator into the fan electrical circuit.

CONTACT ARM SPINDLE : cost Re. 0.25; its function was to mount the contact arm in order to facilitate its movement over the contacts when controlling the fan speed.

SPRING-LOADED PLUNGER: cost Re. 0.32; it positioned the contact arm on the selected contact point and acted as an insulated stop for the contact arm in its extreme positions.

TWO INSULATED SOCKETS WITH NUTS: cost Re. 0.50; they were used to fix the laminate plate to the baseplate and for securing the bakelite cover.

BAKELITE CONTROL KNOB: cost Rs. 1.12; it allowed the spindle to be turned for selecting fan speeds and to protect the user from electric shocks.

CONTACT ARM: cost Re. 0.33; its function was to connect the selected contact point with the contact segment and complete the electrical circuit to the fan unit; connections were made by plated copper wires to the resistance wire tappings.

CONNECTING WIRES: cost Re. 0.10; they connected the different resistance wire tappings to the contact points; connected one terminal to the contact segment and the other terminal to the 'ON' contact point.

FIXING SCREWS: cost Re. 0.30; they secured porcelain insulator to the baseplate and held the bakelite cover in place.

NAME PLATE: cost Re. 0.15; it served to identify the fan regulator and its specifications.

The total production cost of the components came to Rs. 11.00, which meant that a cost reduction of Rs. 1.50 at least was needed to comply with the Terms of Reference. The breakdown of the selling price of the fan regulator was:

Production costs	Rs. 11.00
Production margin (27%)	3.00
Price to Distributor	14.00
Distribution margin (13%)	2.00
Price to retailer	16.00
Retailing margin (25%)	4.00
Selling price	20.00

2. Analysis Syndicate Meeting: the syndicate met and the following summary gives the ideas that were developed with a view to improving the value of the fan regulator. The syndicate analysed the data collected by using the Ten Tests for Value and rated each component according to its value within the framework of the Terms of Reference. The components were scrutinised to determine which could be eliminated, improved, or replaced with alternatives.

BAKELITE COVER: this cover was essential functionally, but its cost was greatest of all components; bakelite was a thermo-setting granular plastic that required a simple moulding machine. However, it was expensive and alternative plastics should be considered, along with hardboard, wood, plasticised paper pulp, pressed steel sheet, Perspex, leather board and aluminium.

METAL BASEPLATE: it was essential also, but its cost was high. Ideas for reducing cost included, reduced size and alternative materials like plywood, asbestos, aluminium, or hardboard.

RESISTANCE WIRE AND CONTACTS: the costs were competitive, but the overall costs should be reduced by eliminating one or two of the tappings, because six fan speeds were excessive. The slower speeds were used rarely, yet greatest at these settings; their elimination should be considered.

CONTACT SEGMENT: this was too costly for its function and redesigning it should save 2/3rds of its cost. It was an essential component for this type of control unit.

CONTROL SPINDLE, KNOB AND CONTACT ARM: Each of these components made large contributions to the total cost. Several ideas were developed to improve their value; most ideas were based upon improving the present design; but one good idea was to replace the rotary unit by a switched unit. It was decided to collect more data on the speed control unit.

SOCKETS AND NUTS : the bakelite moulding around the sockets was superfluous and its removal would save about Re. 0.15. This component was needed with improvements.

Name plate: this component was unnecessary, because the manufacturer's name appeared on the bakelite cover and the regulator's specifications and serial number could be die-stamped into the baseplate to reduce cost.

Other components: were disregarded for cost reduction as they gave small improvements compared with those discussed above. All the ideas for improving value were studied in detail by members before the next syndicate meeting when their practicalities were considered.

3. Record of Minutes: the Secretary of the syndicate produced minutes for the analysis meeting to act as a guide for the members when they collected specific data relating to the ideas developed.

4. Speculation Syndicate Meetings: members' ideas were developed into definite suggestions with the help of the further data collected. A suggestion was a practical idea although it needed testing before it could be recommended as a sure way of improving the value of the fan regulator.

As for analysis, speculation proceeded systematically, component by component, dwelling longer on the most expensive ones.

BAKELITE COVER: costs of alternative materials were obtained as follows:

(i) High density moulded plastic, the cost was Rs. 10.00 per kg. plus injection moulding cost of Rs. 5/- per kg., The cover cost in this material would be Rs. 2.05 each with a weight of 130 gm., effecting a saving of Re. 0.45.

(ii) Plasticised paper pulp could be insulated and made more durable by coating with fibreglass, the new cover cost should be Rs. 1.50, saving Re. 1.00.

(iii) Pressed steel sheet was the cheapest material, even after painting and pressing, costing Rs. 1.35 per cover. It was heat resistant, durable, easily assembled, but would need insulated mountings.

(iv) Aluminium sheet was cheaper than the present bakelite cover, but it would cost around Rs. 2.00 which prevented it from competing with plastic and pressed steel sheet.

METAL BASEPLATE : the present plate measured $6\frac{1}{2} \times 4\frac{1}{2} \times 16$ g. and this odd size caused wastage when cutting from standard sheets. Reducing the base plate size to 6" × 4" would reduce its cost to Re. 0.40, saving Re. 0.35. Other materials were considered unsuitable or more expensive.

REGULATOR CONTROLS: the number of contact points could be reduced to four and one member produced an old model fan regulator with twelve tappings, showing that the number of speeds had been reduced before. Reducing intermediate speeds to two would save Re. 0.20 on contact points and Re. 0.04 on connecting wires, making a total saving of Re. 0.24 on this component.

Redesigning the control unit was quite simple, the syndicate considered a modified contact arm and plate, also it suggested redesigning the control unit to utilise piano-type switches. The present design was considered to be too complicated and the impovements suggested were:

(i) Thinner brass or cadmium-plated contact points and segment.

(ii) Redesigning the contact arm to give more positive positions when engaged with the segment, in order to eliminate the spring-loaded plunger. A working drawing was made.

(iii) Reducing the size of the bakelite knob.

(iv) Redesigning the spindle for the contact arm.

All these improvements would save Rs. 2.00 approximately. In the case of a piano-type switched control it was suggested that the baseplate and resistance unit should be retained and the rotary control replaced with 3 switches: one giving 'ON' and 'OFF' and the other three giving three different fan speeds. The control unit cost was expected to be reduced from Rs. 6.35 to Rs. 2.45, saving Rs. 3.90.

SOCKETS AND FIXING SCREWS: the sockets and screws hold the laminate plate to the screws of the cover plate. It was suggested with the aid of a drawing, that the fixing screws could perform both functions, thereby eliminating the sockets and saving Re. 0.30.

Other Speculation Meetings were held in order to crystallise the suggestions at the design stage before investigating them.

5. Investigation

Between the Speculation and Recommendation Syndicate Meetings the members investigated the suggestions so that their final recommendation would have a factual foundation.

BAKELITE COVER: the cost of Rs. 2.05 for high density plastic; Rs. 1.50 for fibre-glass coated moulded paper pulp and Rs. 1.35 for pressed steel sheet per piece, were confirmed and all could be recommended for cost reduction.

METAL BASEPLATE: the modified baseplate size of $6'' \times 4'' \times 16$g. was found to cost Re. 0.30.

REGULATOR CONTROLS: working models of the new regulators suggested were tested and the following costs were confirmed:

(i) 4-speed model to present design —Rs. 6.01

(ii) Redesigned rotary control unit —Rs. 4.35

(iii) Redesigned piano-type switch unit —Rs. 2.45

The latter design would also save other materials by reducing the size of the complete regulator.

SOCKETS AND FIXING SCREWS : the elimination of sockets was perfectly feasible; tapping the baseplate and using fibre washers for insulation would reduce the cost of these items to Re. 0.20 thereby saving Re. 0.30 per piece.

6. Recommendation Syndicate Meeting

The syndicate prepared a Value Ratio for the desired improvement.

$$\text{Value Ratio} = \frac{\text{New Value}}{\text{Old Value}}$$

$$= \frac{\text{Old Cost}}{\text{New Cost}};$$

$$= \frac{\text{Rs. } 11.00}{\text{Rs. } 9.50} = 1.160$$

The syndicate was an advisory body that lacked the authority of management to implement its recommendations; therefore, it had to report its findings to management in such a way that implementing the suggestions with the best Value Ratio gave the desired value improvement. For this purpose, one of the members was appointed as the Implementing Member in order to advise the management when implementing the recommendation.

The final cost tables for the three proposals were combined to assist the management in making its decisions. (see P.426)

The syndicate discussed the three proposals and decided to recommend the switched control unit for implementation, because it gave the best value ratio.

7. Implementation

Management congratulated the Syndicate, upon achieving the desired value improvement and it decided that the redesigned rotary control unit should be implemented immediately; later it would be replaced with the recommended switched unit.

Final Cost Tables Combined

COMPONENTS	OLD COST	NEW COSTS		
		Proposal Nos.		
		I	II	III
		4 speeds only	Switched control	Redesigned rotary control
	Rs.	Rs.	Rs.	Rs.
Bakelite cover	2.50	2.07	1.50	2.50
Metal baseplate	0.75	0.30	0.20	0.75
Porcelain insulator	0.20	0.20	0.20	0.20
Resistance wire	1.05	1.05	1.05	1.05
Laminate plate	0.58	0.58	—	0.58
Contact points	0.84	0.64	—	0.40
Contact segment	0.51	0.41	—	0.35
Terminals	0.25	0.25	0.25	0.25
Spindle	1.50	1.50	—	0.50
Spring loaded plunger	0.32	0.32	—	—
Sockets and nuts	0.50	0.20	0.50	0.50
Control knob	1.12	1.12	—	1.12
Contact arm	0.33	0.33	—	0.25
Connecting wires	0.10	0.06	0.10	0.10
Fixing screws	0.30	0.30	0.30	0.30
Name plate	0.15	0.15	0.15	0.15
Six speed switched control unit	—	—	2.10	—
Total Costs	11.00	9.48	6.35	9.00
Value Ratios	—	1.165	1.737	1.225

STUDY NO. 5

The Carbon Company Case

Subject Selected: **Minimax Socket Assembly**

Objective of Analysis: To increase the value of a minimax socket unit for a dry cell energizer.

INTRODUCTION

Terms of Reference

1. The socket unit must provide positive and negative terminals for connecting a dry-cell battery into a transistor radio circuit with a two pin plug.
2. The unit must fit into the end of the battery carton and comply with radio manufacturers' specifications for two-pin sockets.
3. The socket terminals must be insulated, provide an electrical connection with the battery cells.
4. The unit must be rigid and leak-proof.
5. The present cost must be reduced by 25%.

Syndicate

Coordinator	..	Design Engineer
Secretary	..	Research and Development Executive
Implementing Member	..	Industrial Engineer
Specialists	..	Purchasing Executive, Manufacturing Executive.

Syndicate Agenda

1. Select a coordinator and secretary
2. Discuss the terms of reference.
3. Collect relevant information.
4. Arrange an analysis syndicate meeting.
5. Prepare record of the ideas analysed.
6. Speculate on practical application for these ideas.
7. Make a recommendation for increasing value.
8. Prepare a report of proceedings and recommendation.
9. Appoint a member to advise on implementing the recommendations.
10. Evaluate the complete project.

PROCEDURE

The DARSIRI Method of Value Analysis was used to increase the value of the minimax battery socket units and the procedure had the usual seven steps.

1. Data Collection

PRODUCTION VOLUME: 3,500,000 minimax socket units per year.

MANUFACTURING COST: the present cost of manufacturing minimax socket units was Rs. 0.17 per piece.

Manufacturing Method: the method of manu-

facture was entirely manual and the only equipment employed was a soldering iron and a foot-operated press. There were three semi-skilled operators for performing the work; after assembly the complete battery was protected by dipping it into wax to present electrical leakage.

Components of the socket unit:

(a) 2 spring-brass terminals and sockets 0.01″ thick, the positive and negative terminal widths were 0.795″ and 0.575″ respectively.

(b) 2 Hylam laminate insulating strips, 1/32″ and 1/16″ thick.

(c) 1 Duplex card strip, 0.018″ thick which composed the end wall of the carton.

(d) 2 brass eyelets for clamping the components together.

(e) 1 Thermocole cellular sheet spacer, $1\frac{1}{2}$″ × $2\frac{1}{4}$″ and $\frac{1}{2}$″ thick.

(f) Lead solder for attaching the battery wires to the terminals.

Cost of alternative materials:

Polystyrene	=	Rs. 11.50	per kg.
Polythene	=	Rs. 4.50	,, ,,
PVC	=	Rs. 7.00	,, ,,
Bitumen	=	Rs. 500.00	per tonne

2. Analysis Meeting

The value of the minimax socket unit would be increased by reducing the direct costs; therefore, cost data had been collected for all materials, labour, equipment and overheads involved. The answers to the Ten Tests for Value were rated in order to indicate the best areas for reducing cost.

The costs were expressed as rupees per 1000 pieces

Cost Data

Components	Materials	Labour	Equipment	Overheads
Wax dipping	0.79	0.70	0.65	0.79
0.575″ brass terminal	7.25	3.20	—	0.97
0.795″ brass terminal	9.45	3.20	—	0.98
1/32″ Hylam laminate strip	14.41	1.24	—	0.41
1/16″ Hylam laminate strip	25.27	1.24	—	0.41
Duplex Card Strip	2.25	2.15	—	0.85
Solder	1.91	—	1.25	—
Brass eyelets (2)	21.11	—	1.37	—
Thermocole sheet pad	62.00	1.35	—	0.50
Assembly	—	8.02	—	0.88
Cost totals	144.44	21.10	3.27	13.79

Costs Grand Total=Rs. 182.60 per 1000 pieces

Ten Tests for Value :

1. The function of the socket was essential for an energizer. Rating A.
2. The cost was not proportional to usefulness. Rating BC.
3. All features would be needed after improvement. Rating B.
4. The socket was specific dimensionally for this type of energizer. Rating A.
5. Most items could be made cheaper. Rating BC.
6. The efficiency of production methods could be increased. Rating BC.
7. Some standard items could be used. Rating C.
8. The terms of reference took profit into account. Rating A.
9. It might be possible to obtain cheaper supplies. Rating C.
10. Alternative designs and methods were feasible. Rating C.

There was a preponderance of B and C ratings showing that value could be increased most readily by making improvements to the existing socket unit, or by using alternative designs and manufacturing methods. The ideas with greater potential were:

EYELETS: a dual function of riveting the insulating strips with the terminals and serving as socket was visualised for the eyelets.

MOULDED UNIT: moulding could eliminate the insulating strips and the thermocole space; it was likely that a specially moulded plastic unit with holes for the brass sockets and terminals could be produced.

THERMOCOLE: this was an expensive imported material which served only as an insulated spacer. In order to increase value, a cheaper alternative material should be considered.

WAX: wax dipping appeared to be a wasteful operation.

ALUMINIUM: brass was more expensive than aluminium and replacing it should be considered.

STEEL: zinc, cadmium, tin or chromium-plated mild steel strip would be cheaper than brass.

HYLAM: This was an expensive laminate that might be reduced in thickness yet provide adequate insulation.

SILICA GEL: alternative forms of moisture proofing should be considered, including silica gel crystals.

THERMOCOLE: this material was mouldable and using a rectangular spacer cut from a sheet was wasteful; probably, moulding it would have the amount of material required.

NUMBER OF COMPONENTS: the number of components for the basic function appeared to be excessive: a single moulded insulator could replace the Thermocole, Hylam, Duplex card and eyelets. An affiliated company manufactured polythene which was a suitable material for moulding. Polythene would allow the socket to have flexibility for inserting the plug pins.

SOLDERING: crimping the battery wires to the terminals should be adequate for electrical contact and it would eliminate solder. The amount of solder used was excessive anyway.

BITUMEN FILLING: this idea envisaged the brass sockets being positioned in a jig before pouring bitumen around them so that the bitumen solidified to hold the sockets in place and to act as an insulated spacer.

PVC STRIPS: the Hylam laminate strips were costly and they should be replaced with cheaper material such as PVC: thermal fusion of the PVC would eliminate brass eyelets.

TERMINALS: soldering appeared to be unnecessary because crimping wires to terminals was quite effective.

PFR SHEET: phenol formaldehyde resin sheet was about half the cost of Hylam sheet and 1/32" thickness seemed sufficient.

3. Record of Ideas

The Secretary of the syndicate recorded the ideas described above and prepared the agenda for the first speculation meeting. They served

as a guide for the members when collecting additional information relevant to the ideas analysed.

4. Speculation Meetings

The ideas formed at the analysis meeting were developed into practical applications during two speculation sessions and the following suggestions were recorded.

Moulded Plastic Socket Unit: combining the insulating and spacing features as a moulded unit was examined carefully and it was thought that brass sockets could be inserted at the time of moulding. Alternatively, injection moulded units could be bought in and the sockets could be inserted at assembly stage, if inserting them at the moulding stage was impractical.

Bitumen filling: a suitable therm-setting bitumen was Mexphalte R 85/45 which had a melting point below that of the wax which protected the complete battery. Therefore, it could be poured after the socket unit was in place at the end of the battery cells. However, modification of the assembly method was necessary, namely, crimping the battery wires to the terminals before positioning them in a jig; then pouring bitumen into the space: allowing it to cool for one to two minutes; removing the jig which had pins and pressing the Duplex card into place and allowing another three minutes for complete cooling. The production rate was estimated at 600 pieces per hour, the jig life at two years and the capital cost at Rs. 1,000/- for equipment.

Moulder paper socket unit: as an alternative to plastic, the insulated components of the socket unit could be moulded from silicon-impregnated paper pulp. It was suggested that the cost of a unit would be reduced further by using aluminium eyelets for pressing the terminals to the moulded paper component.

Modified basic design: alternative materials could be used to cheapen the existing design; for example, PFR sheet replacing Hylam, using chromium plated mild steel terminals and sockets, aluminium eyelets and a corrugated cardboard spacer.

5. Investigation

The four suggestions for improving the value of manufacturing battery socket units were investigated in order to determine their suitability and costs.

Plastic moulded unit: although several components were eliminated, depreciation on the Rs. 50,000 invested in an injection moulding machine or purchasing ready made components raised the indirect overheads. The moulder could be used for additional products and replacement was expected to be necessary in four years time. Costs were expressed as rupees per 100 pieces:

Cost Data

Components	Materials	Labour	Equipment	Over heads
Wax dipping	0.79	0.70	0.65	0.79
Injection moulding	104.00	1.50	2.80	5.65
0.575″ chromed steel	5.15	3.20	—	0.97
0.795″ chromed steel	7.00	3.20	—	0.98
Duplex card	2.25	2.15	—	0.85
Assembly	—	6.00	—	6.00
Cost totals	119.19	16.75	3.45	15.24

Costs Grand Total = Rs. 154.63 per 1000 pieces

Bitumen filled unit: the cost of a jigs was an additional overhead charge, but the Thermocole spacer, Hylam strips and brass eyelets were eliminated. The wires were assembled by crimping. Costs were expressed as rupees per 1000 pieces.

Components	Materials	Labour	Equipment	Overheads
Wax dipping	0.79	0.70	0.65	0.79
Bitumen filling	30.00	0.75	8.00	1.50
0.575″ spring-brass	7.25	3.20	—	0.97
0.795″ spring-brass	9.45	3.20	—	0.98
Duplex card	2.25	2.15	—	0.85
Assembly	—	7.50	—	8.25
Cost totals	49.74	17.50	8.65	13.34

Costs Grand Totals = Rs. 89.23 per 1000 pieces.

Paper moulded unit: the Thermocole spacer and Hylam strips were replaced by silicon impregnated paper pulp and the terminals and Duplex card were joined to it with aluminium rivets, whilst the wires were joined by crimping.

Costs Expressed as Rupees per 1000 Pieces

Components	Materials	Labour	Equip-ment	Over-heads
Wax dipping	0.79	0.70	0.65	0.79
Paper moulding	41.50	5.65	5.00	1.75
0.575" spring-brass	7.25	3.20	—	0.97
0.795" spring-brass	9.45	2.15	—	0.98
Duplex card	2.25	2.15	—	0.85
Aluminium rivets	10.00	—	1.25	—
Assembly	—	5.00	—	5.50
Cost totals	71.24	19.90	6.90	10.84

Costs Grand Total = Rs. 108.88 per 1000 pieces.

Modified basic unit: the existing socket unit design remained the same, but cheaper materials and method were useds during the manufacture.

Costs Expressed as Rupees per 1000 Pieces

Components	Materials	Labour	Equip-ment	Over-heads
Wax dipping	0.79	0.70	0.65	0,79
0.575" chromed steel	5.15	3.20	—	0.97
0.795" chromed steel	7.00	3.20	—	0.98
2×1/32" PFR laminate	15.00	2.50	—	0.80
Duplex card	2.25	2.15	—	0.85
Aluminium eyelets	15.00	—	1.37	—
Corrugated cardboard	34.00	1.35	—	0.50
Assembly	—	8.02	—	8.88
Cost totals	79.19	21.12	2.02	13.77

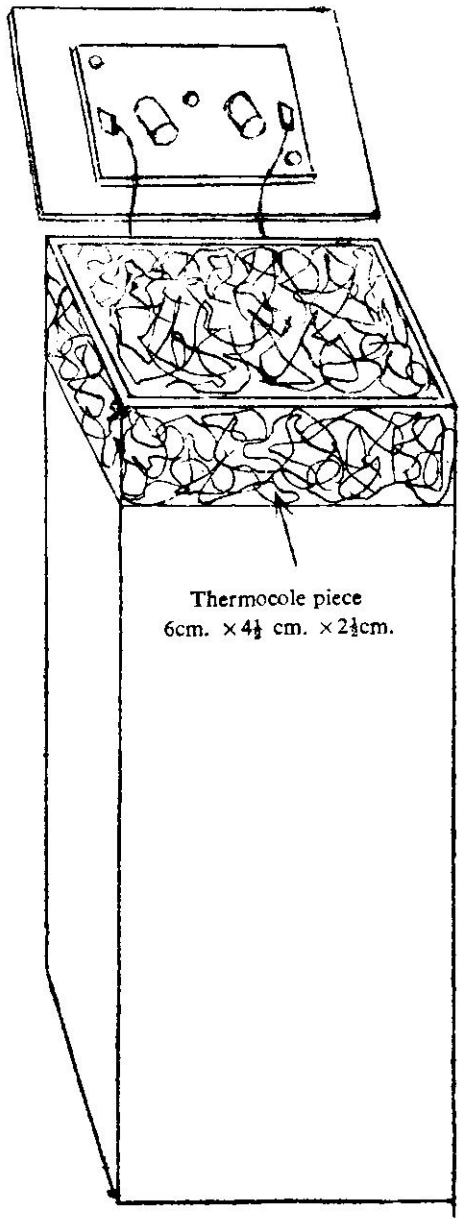
Cost Grand Total = Rs. 116.10 per 1000 pieces.

6. Recommendation Meeting

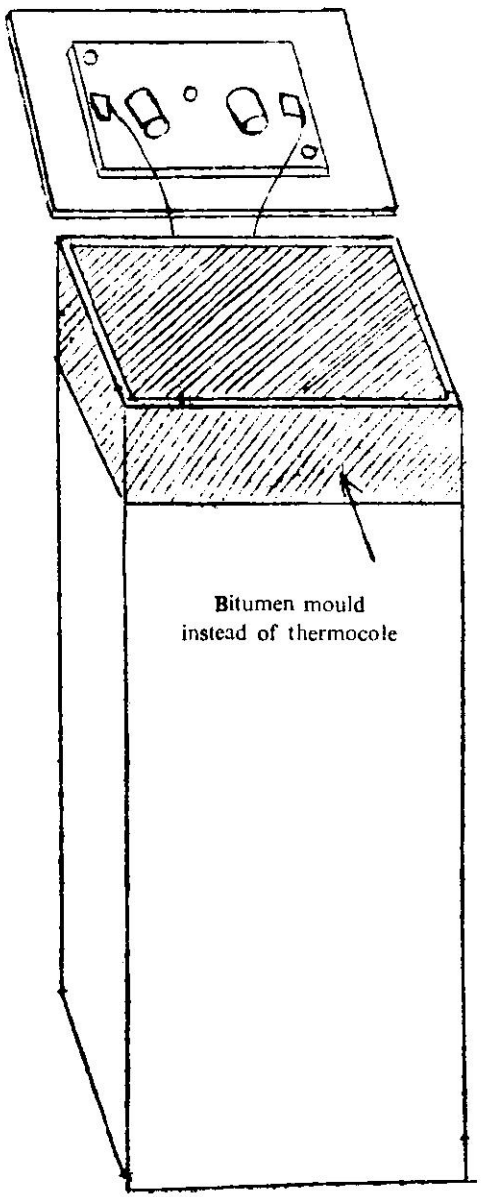
The four suggestions investigated were feasible and all provided an increased value when compared with the original cost in the form of a Value Ratio. The ratio needed to comply with the terms of reference was 1.333.

BATTERY ENERGIZER

Old Design



New Design



$$\text{Value Ratios} \quad \text{Value Ratio (V.R)} = \frac{\text{Old cost}}{\text{New cost}}$$

Plastic moulded unit:

$$\text{V.R.} = \frac{182.60}{154.63} = 1.181$$

Bitumen filled unit:

$$\text{V.R.} = \frac{182.60}{89.23} = 2.047$$

Paper moulded unit:

$$\text{V.R.} = \frac{182.60}{108.80} = 1.677$$

Modified basic unit:

$$\text{V.R.} = \frac{182.60}{116.10} = 1.572$$

Recommendation : the suggested plastic moulded socket unit involved the greatest capital investment and it had the smallest value ratio; but the other suggestions were fairly straightforward and the bitumen filled unit proved to be the best. Consequently, it was recommended that the minimax socket unit be modified to replace the Thermocole spacer, the Hylam strips and the brass eyelets with Mexphalte R85/45 bitumen in order to increase its value by 104.7%. The financial saving should be:

Rs. 182.60—Rs. 89.23=93.37 per 1000 pieces.

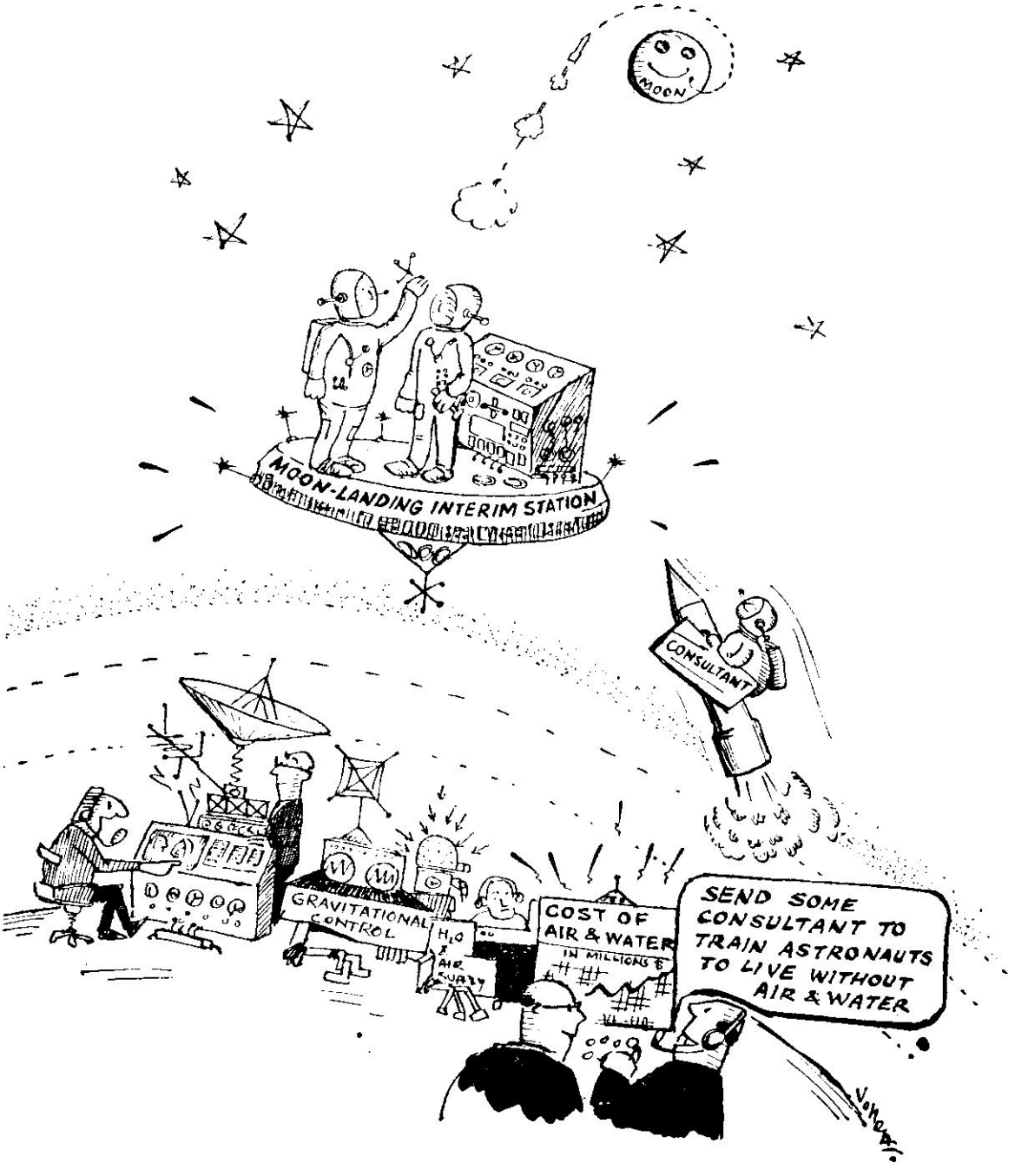
The annual saving should be: $\frac{93.37 \times 3.5 \times 10^6}{103}$

=Rs. 3,26,800.

The industrial engineer was selected to be the implementing member, should this recommendation be acceptable to management.

7. Implementation

Since the report had been submitted to management only recently, their decision on this recommendation was awaited at the time of writing. The cost reduction required was 25% and the recommended socket unit cost is expected to give a reduction of about 48% which should be highly statisfactory.●●●


MOON
MOON-LANDING INTERIM STATION
CONSULTANT
GRAVITATIONAL CONTROL
COST OF AIR & WATER
IN MILLIONS $
SEND SOME CONSULTANT TO TRAIN ASTRONAUTS TO LIVE WITHOUT AIR & WATER

Fiftieth Anniversary of the ILO*

FIFTY YEARS AGO, THE FIRST WORLD WAR was drawing to a close. Men's minds were beginning to turn to peace—and to the foundations upon which an enduring peace might be constructed. The peace treaty, signed on June 28, 1919, established the League of Nations, which had as its principal object the prevention of further wars.

The treaty recognised that universal peace "can be established only if it is based upon social justice." And so the International Labour Organisation (ILO) was created alongside the League, with the responsibility of organising international collaboration in dealing with labour problems, including, in particular, the development of international standards for workers' protection.

The ILO was the only major League of Nations body to survive the chaos of the Second World War. Relying on the confidence of workers, of employers, and of governments, and drawing on its capital of achievement, the ILO prepared to face the future.

Protection of Workers

In Philadelphia in 1944, the organisation marked its first quarter-century by issuing a declaration containing a forceful reaffirmation of the primacy of the social objective and of the continuing role of the ILO in the struggle against poverty and insecurity. After becoming, in 1946, the first specialised agency associated with the United Nations, the ILO threw its full weight into a new and essential undertaking: international technical cooperation. At the same time, it continued without abatement its efforts for the protection of workers.

There were 45 member States in 1919. Today there are 118. As the organisation nears the end of its first half-century, the influence of its standard-setting work is felt in virtually every corner of the world, and its operational activities span the globe.

On June 26, 1967, the International Labour Conference unanimously resolved to celebrate in 1969 the 50th anniversary of the founding of the ILO. The text of this resolution was forwarded to all member States, to employers' and workers' organisations, to the United Nations, the specialized agencies and regional organisations, and to non-governmental bodies having relations with the ILO.

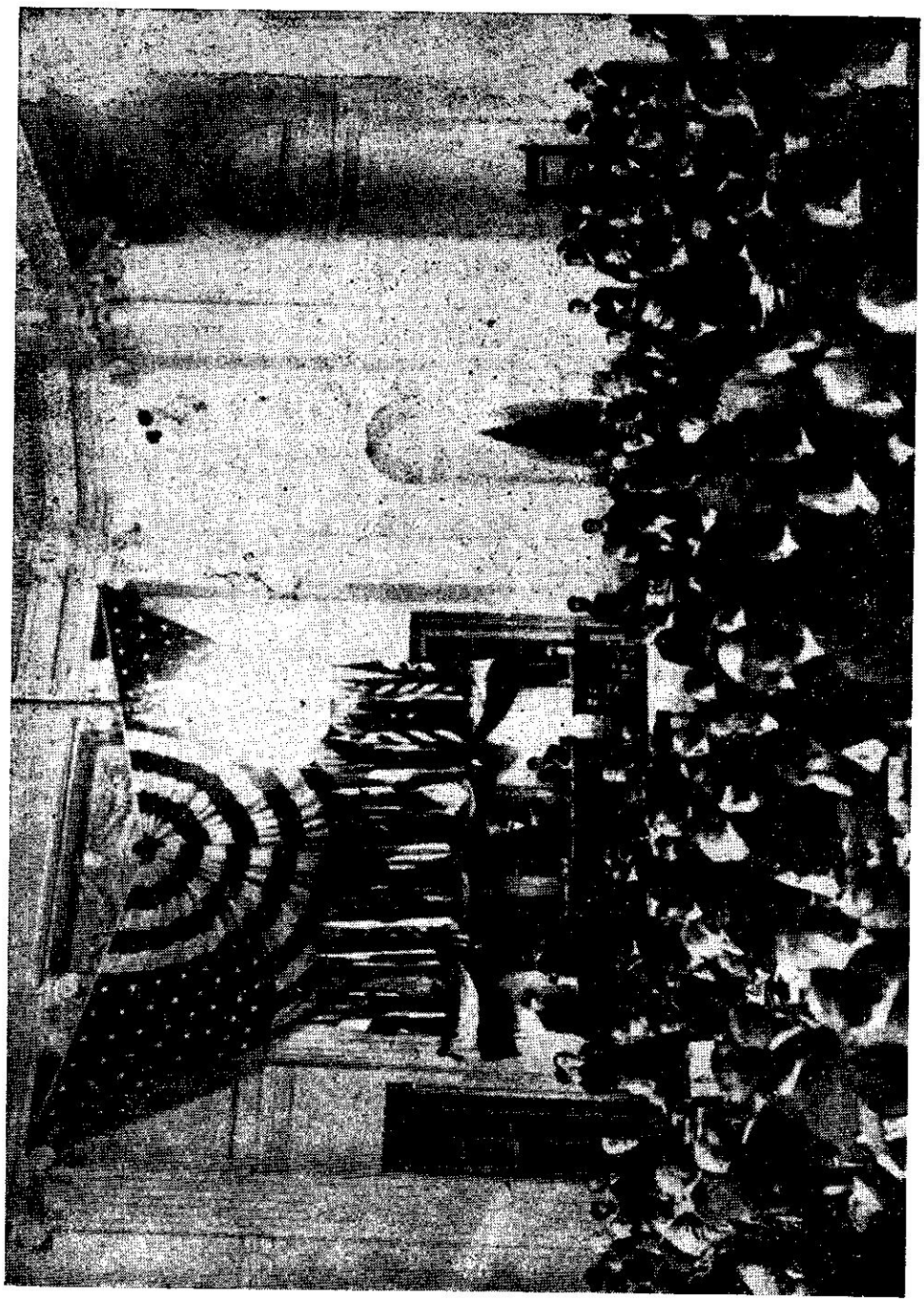
The Governing Body of the ILO had already set up an anniversary committee, and in October 1967 the Director-General appointed Kalman Kaplansky, Director of the Canada branch office of the ILO, as 50th Anniversary coordinator. A former Workers' member of the Governing Body and former Director of the International Affairs Department of the Canadian Labour Congress, Mr. Kaplansky has long been active in public affairs.

Purposes of Celebration

The purposes of the celebration, as laid down by the International Labour Conference, are to promote broader understanding of, and more active support for, the objectives of the organisation; to intensify the continuous and concerted international effort to promote the common welfare in freedom and dignity, as provided for in the ILO Constitution and in the Declaration of Philadelphia; and so to contribute to the establishment of universal and lasting peace on the basis of social justice.

The emphasis will be upon the future rather than the past. The ILO is a living organisation

*Reprinted by permission from *American Labour*, June 1969. The original appeared in the *ILO Panorama*.



On October 29, 1919 the ILO held its first session in the Pan American Union building in Washington. Worldwide celebrations this year mark the completion of the first half-century of the organization's service.

whose chief concern is to enhance its future contribution to the well-being of the peoples of the world. It follows that, while due attention will be paid on the occasion of the 50th anniversary celebration to the organisation's record of achievement, and to the experience which has made it an effective instrument for progress, the main theme of the celebration will be the capacity of the ILO for greater achievement in the future.

This forward-looking approach is emphasised by the fact that the World Employment Programme, a most ambitious and far-reaching enterprise with great potential for raising living standards throughout the world, will be officially launched in the anniversary year.

Plans are now well in hand for the commemoration of the anniversary. During the International Labour Conference in Geneva in June 1969 celebrations of an international character marked the occasion. A special sitting of the conference was held in which distinguished persons in international and national affairs took part.

At Geneva and Throughout World

Information reaching Geneva from member States, trade unions, employers, and organisations of various kinds indicates that ceremonies will also be held in many parts of the world. This is in response to a list of suggestions forwarded by the Director-General to all member States in February 1968.

In a number of member States, national committees of government, employer and worker representatives have been formed for the purpose of organising the celebration of the anniversary; in several cases these committees also include representatives of the press, United Nations Associations, and other interested bodies. The committees are already planning public meetings, conferences, academic discussions, debates, and theatrical and musical presentations.

The official date chosen for the commemoration is October 29, the 50th anniversary of the opening of the International Labour Conference. On that day national celebrations will culminate, in many countries, with a major national ceremony attended by the Head of State, including in some cases a full parliamentary debate on the participation of the member State in the ILO. In most cases this examination will include a review of the contribution the country has made to the ILO and the impact the ILO in turn has had on the country's laws and ways of life.

Promoting Social Justice

Workers' and employers' organisations throughout the world are expected to mark the anniversary in their own way. In many countries the work of the ILO to promote social justice and the hope it holds out for future progress will be featured at annual conferences and in Labour Day observances. International trade-union organisations also have plans in hand for marking the occasion.

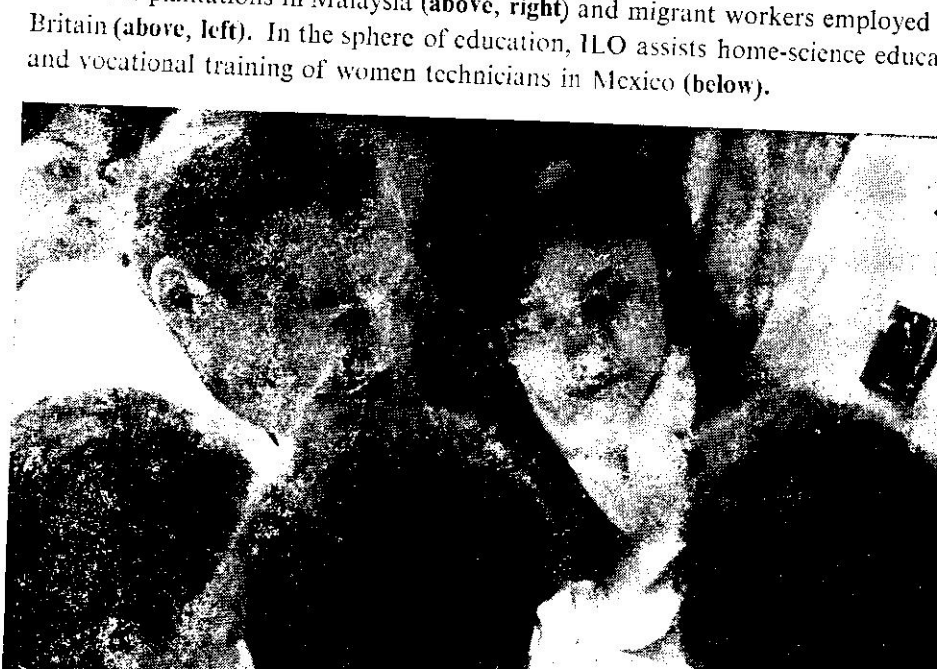
In many countries, labour colleges will be setting up exhibitions and setting a time aside for anniversary lectures and week-end schools devoted to the history and future objectives of the organisation. Special issues of trade-union journals and employers' publications are planned.

United Nations Day 1969, which falls just five days before the 50th anniversary of that first session of the International Labour Conference, will highlight the achievements of the International Labour Organisation and will have as its theme "Social Justice and Peace". ILO Director-General David A Morse will address the General Assembly, and television broadcast relays will bring his message to the world.

Not for Just a Day

Activities to mark the occasion will be scheduled by the ILO's sister organisations in the UN family and by other intergovernmental organisations such as the Organisation of American States, the League of Arab States, and the Council of Europe. The ILO has, for instance, been invited to submit a special report to the Consultative Assembly of the Council

ILO's wide-ranging concerns include working conditions of labour, such as thos on rubber plantations in Malaysia **(above, right)** and migrant workers employed Britain **(above, left).** In the sphere of education, ILO assists home-science educa and vocational training of women technicians in Mexico **(below).**



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

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

Future Tasks

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

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

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

Lord Snowdon

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

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