norm or base above which bonus is to be paid; and (c) establishing a relationship between productivity and bonus.

Illustrative Schemes :

(*1*) *Production in Physical terms (units, tonnes, etc)* :

Production (tonnes pa)	*Bonus rate*	*Bonus %*	*Cumulative*
—15,000	—	4% of gross annual earnings (Basic+DA)	4%
15,001—17,000	0.002	4% —do—	8%
17,001—18,000	0.003	3% —do—	11%
18,001—19,000	0.004	4% —do—	15%
19,001 and above	0.005	5% —do—	20%

(e.g. Indian Aluminium Co. Annual Productivity Bonus Scheme)

Note : (i) If the total employee strength is kept constant the above basis of production will automatically give productivity base.

(Ii) Manpower changes should be on the basis of work study

(iii) Multiproduct companies should evolve factors to convert various products to the common basis of standard product.

(*2*) *Productivity* : Payment can be related to slabs of productivity indices expressed in units per manhour as in the Productivity Index Plan of Vazir Sultan Tobacco Co. Ltd.

Slab	*Productivity Index*	*A*	*B*	*C*	*D*	*Block Amounts*
1	1.885 to 1.909	...	...	...	...	8.40
2	1.910 to 1.935	...	...	...	...	8.45
—	—	...	...	...	...	—
—	—	...	...	...	...	—
40	2.873 to 2.898	...	...	...	...	11.17
41	2.899 & above	...	...	...	...	11.27

(3) *Production/Price/Cost Formula :* A base production level coupled with a base price and base cost can be related to % annual bonus at a certain rate and variations in the production, price and cost figures, adjustment factors expressed as percentages added or subtracted from the standard % can be fixed as follows :

(a) *Production*		(b) *Price*		(c) *Cost*	
Units of Production	*% AB*	*Price per Unit*	*% AB Variations*	*Cost Per Unit*	*% AB Variations*
1600	4	10.00	— 5	7.5	+ 5
1700	8	11.00	— 3	8	+ 4
1800	12	12.00	— 1	9	+ 2
1900	16	12.50	0	10	0
2000	20	13.00	+ 1	11	— 2
AB=Annual Bonus		14.00	+ 3	12	— 4
		15.00	+ 5	12.5	— 5

(4) *Gross Sales Value :*

	Share of Employees
Rs. 8.5 to 10.0 lakhs	5% of excess above base
Above Rs. 10.0 lakhs	$7\frac{1}{2}$% -do-

Note : (iv) Ease level should be fixed by the breakeven analysis

(v) To avoid market fluctuations of prices affecting bonus earnings the value may be computed at constant prices, (e. g. 1960-61=100)

(5) *Ratio of Output to Input expressed as* $\frac{\text{Gross Sales Value}}{\text{Total cost}}$

(6) *Value added :*

	year 1	*year 2*
(i) Net Sales Value	60,000	90,000
(ii) Material & Throughput	24,000	36,000

(iii) Value Added	36,000	54,000
(Iv) Incremental Value	18,000	

Incremental Value	*Bonus %*
9,000	5%
18,000	10%
27,000	15%
36,000	20%

Note : i) Manpower input to be kept constant as in illustrative example (1)

ii) Net Sales = Gross sales minus excise duty, sales tax and other sales expenses

iii) Throughput may include freight, and transport, rent, interest, depreciation, taxes, insurance and other service charges.

iv) There is no justification for including return on capital (whether preferred or equity shares) here as a prior charge expense. While owners are investing capital, the workers are investing their labour power in an enterprise. If priority in return is claimed by one it cannot be denied to the other. Such a move will only reinforce the claim of labour for a similar payment to them like the deferred wage component of bonus. In tact, the surplus value created should be shared equitably among owners, company workers, consumers and the country (community at large) in an acceptable manner.

(7) *Value Added per employee expressed as*

$$\frac{\text{Total Value Added}}{\text{Total No. of employees}}$$

computed for a base year as well as the current year and percent increase of the current year over the base year being related to Annual Bonus percent.

(8) *Ratio of Value Added to Wage Bill :*

		(a)	(b)	(c)	(d)	(e)
i)	Value added	36.000	45,000	54,000	63,000	72,000
ii)	Wage Bill*	18,000	18,000	18,000	18,000	18,000
iii)	Ratio	2.0	2.5	3.0	3.5	4.0
iv)	Index	100	125	150	175	200
v)	Bonus percent	4	8	12	16	20

*Wage Bill may include Wages/Salaries, Incentives, Welfare Expenses and contribution to PF, Gratuity, etc.

(9) Ratio of Wage Bill to Value Added :

If this ratio is 50 percent for the base period and it is applied to the other year, a standard 'wage' bill is obtained :

i) Value Added	36,000	45,000	54,000	63,000	72,000
ii) Standard Wage Bill	18,000	22,500	27,500	31,500	36,000
iii) Savings in Wage Bill	—	4,500	9,000	13,500	18,000
iv) Bonus percent	4	8	12	16	20

(10) Performance Index

$$\text{i. e., } \frac{\text{Standard manhour content of total production}}{\text{Actual manhour input for the year}}$$

can be related with bonus per cent.

Problems Can be Overcome

Since a few methods are indicated in a grossly oversimplified manner, it should not be assumed that things are that easy. Many thorny problems will have to be discussed and mutually acceptable solutions found, if these ideas are to be tailor-made to suit each organisation and implemented. When we get incremental values of production, productivity, value added, etc., it should be appreciated that several factors like quality of labour force, effectiveness of work, improved technology, additional capital input, better machinery, better organisation, better management etc. would have contributed to this and it is not always easy to isolate the contribution of labour. When changes occur in any one of the above factors, managements and union should negotiate and change base level. Such a flexibility is the dynamic life force of any live human relation system or, for that matter, any socio-economic system providing for growth-enabling change. The need for negotiating changes is often characterised by many critics as the negative aspect of the concept of annual bonus linked to productivity. This only reflects the continuing legacy of over-reliance of legal processes in industrial relations and the persisting tendency to play safe. It is high time that we realise that there is no substitue to the need for developing professional management skills.

To fix up a base level (floor) based on breakeven analysis or work study as well as to fix up a ceiling level based on capacity study and then to relate with the minimum and maximum perecentage of bonus on a reliable and acceptable basis, considerable amount of careful work will be required. It is desirable to link the base level to minimum bonus of 4 percent and the optimum level of production (established by capacity study) should be linked to the maximum bonus of 20 percent. This will leave the maximum possible level of production above the maximum bonus of 20 percent, thus providing for setting on the surplus created by production above optimum level as a bonus reserve fund from which payments can be made to set off bonus when the production is below the base level due to reasons beyond the control of both parties. In fact, if the situation of the industry or the unit warrants so, the productivity and profit criteria for annual bonus payment can be combined as follows :

A. Where there is no allocable surplus and no increased productivity	No annual bonus
B. When there is no allocable surplus but there is increase in productivity	Set off payment of bonus
C. When there is allocable surplus but no increase in productivity	No bonus surplus set on
D. When there is allocable surplus and increase in productivity	Bonus payment

(Adapted from the paper, "Linking Annual Bonus to Production/Productivity" by Shri V. K. S. Menon, Director-in-Charge, Steel Complex Ltd., Feroke, presented at the Seminar on the subject held by Kerala State Productivity Council on 4-12-76)

According to the above concept, for alternatives B and D, a formula can be evolved linking both allocable surplus and productivity along the lines indicated in illustrative scheme (3) above.

Inter industry problems, variations between labour-intensive and capital-intensive industries, batch production and mass production, etc., will pose difficult problems in different situations. But most of these problems can be overcome, if there is agreement on the principles of linking productivity with bonus.

Incentive Pay and Annual Bonus

Conceptually, while incentive payment is related with savings in labour cost (time saved or savings in standard wage bill) Annual Bonus is related with overall savings in labour, material and overheads or total surplus. While the former is an immediate short-term payment providing direct motivation to work more and produce more, the latter is a compalratively remote long-term payment providing indirect motivation to app y themselves more effectively to work and generate results. Even when adverse conditions unforeseen earlier, like market fluctuations or force ma-jeure events like power cut, create situations where incentives might become inoperative for a short period, the negative effect of these conditions on operations can be contained within limits and a certain degree of stability can be maintained if an imaginatively conceived annual bonus scheme is in operation. Each has its own role in the motivation of men (INDAL experience).

Monthly incentives and Annual Bonus can be combined in a single scheme like the one in Vazir Sultan Tobacco Co. As a variant of this idea, there can be a ceiling on monthly incentive earning and the surplus of savings (allocable to workers) over the ceiling can be pooled into a fund from which annual bonus can be paid. Since a ceiling is applicable to annual bonus also, this will also provide for a bonus reserve fund into and from which set on and set off can be operated.

Sharing the Gains of Productivity

In the present day context in India, ideally the total surplus should be appropriated in an agreed proportion to:

i) Return on capital for the investors:

ii) Social Investment needs of the country (Unit's contribution to the development of the economy)

iii) Production development needs of the Unit (to the company) to improve technology, plant and machinery, methods, etc.

iv) Consumer Benefit fund (to consumers in the form of better quality of products/services and lower prices)

v) Employee motivation fund (to all working people).

The employee motivation fund can be utilised for:

a) Socio-cultural purposes (for providing better housing, welfare, health and recreation facilities to employees over and above what is done by the Government),

b) Annual bonus (as a share in the surpluses of the enterprises) and

c) monthly incentive pay (a share in the saving of labour).

Golden Mean

In linking bonus to productivity the two extreme approaches of a single straight jacket formula and completely free collective bargaining should be avoided and we should adopt a golden via media. Since productivity problems are different for different industries and various units within the same Industry, a simplistic approach of a uniform formula applicable to all companies and units will be inappropriate. At the same time leaving every detail to be worked out between management and union depending on local conditions and unit level problems without regard to the overall interests of the economy will be inadvisable. General principles and directive guidelines should be evolved region-wise, industry-wise and company-wise based on the generally acceptable understanding about the variables and such guidelines should be translated into unit-level system through mutual discussions to suit the conditions of the particular unit with the overall framework.

Such guidelines may be evolved at the national level by a National Board for Productivity and Incomes, consisting of five members—an industrial economist, a professional management expert, a labour relations specialist, a productivity specialist (work study, job evaluation and industrial engineering) and an experienced administrator—attached to the Ministry of Labour and Employment. It will be helpful if a panel of productivity spcialists is attached to the Central Apex Body for Industrial Relations also to provide data base for solving productivity problems, resolving conflicts and guide them in their deliberations. Correspondingly, State level Wage Boards and Panels of specialists may also be attached to

State Labour Ministries and State Apex Bodies for Industrial Relations to help implement the productivity guidelines to bonus negotiations.

The Only Positive Path

Wasteful exercises in the industrial relations field in the past brought our country to the verge of an economic catastrophe. Pressures to consume more than what is produced and tendencies for consumption to precede production have been mounting in the past. Increased productivity only creates the capital required for reinvestment and growth.

While money wages increased, real wages of workers stagnated in India. Workers stand to gain from linking bonus to productivity. A reward system linked to productivity is one of the very few ways open to our country to stimulate economic development. There is no short-cut to higher real income to workers, better standard of living for the people and progress of the country other than increased productivity. Let us not talk of linking only because the country's leadership is talking about it. Let us do it only if we are convinced of the intrinsic merits of the principle and only when the feasibility for linking is clearly established after proper study.

Let us cast away our doubt and join the battle of rebuilding our economy holding in view lakhs of workers with low wages, the millions of unemployed and underemployed young men and crores of people below the poverty line. We should rediscover the genius of India, evolve strength in our national characteristics and forge new approaches to problems, best suited to the present situation, if we have to do better. It is time to wake up and work hard to rejuvenate our nation. □

Productivity : A Systems Approach

M. G. Korgaonker*

Never was 'Productivity' emphasised more vigorously than in the contemporary world of resource shortage and the complex interrelationships conditions in which organisations have to operate. A nation's productivity is unquestionably regarded as one of the two major determinants of the way of life of its people, the other being its socio-political system. A productive economic system of producing goods and services is necessary for a high standard of living.

The beginning of the productivity movement in manufacturing system dates back to the time of F. W. Taylor and even earlier (Gavett W.). Understandably, the movement received impetus during and after World War II, because of the multiplicity of challenges the war posed. Apart from the United States, countries on the European and Asian subcontinents were amongst the first to recognise the need for increased productivity. There was deliberate attempt on the part of the government of these countries to support productivity programmes and form national productivity bodies. While the movement is percolating to more and more countries, it has gained national priority in developed countries.

Definition and Measurement

Traditionally, productivity is defined as the ratio of output to input. Inputs are predominantly manpower, capital, machinery and energy The output is variously expressed as the number of physical units money value of production, money value of sales, value added by manufacture, etc. The inputs, similarly, could be expressed in terms of man-hours, direct labour costs, total labour costs, total costs, capital costs, foreign exchange usage and so forth. The commonly used indicator of productivity rise or fall is 'productivity index'. Indices used in the past range from the intangible and comprehensive expression of

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GNP per capita to the precise engineering time analysis of man-hours to perform a specific operation in particular factory. Between these extremes, other indices are possible like the general industry index which is the aggregate output per man-hour.

Potential Errors in Measuring Productivity Index

In a productivity improvement programme, determination of a most appropriate productivity index is of utmost significance. For instance, if output is measured in terms of money value of goods produced, it would hardly make sense to compare an output worth say Rs. 1 crore this year with an output of Rs. 1 crore some ten years ago and argue that productivity was same these two years. indeed, a number of errors may be commonly made. Important among these are

1. Use of productivity indices which are not related to improvement.
2. Overly simplistic measures of output.
3. Suboptimisation.
4. Counting outputs in a manner not related to inputs.
5. Counting outputs in a manner not related to goals.

Even if the above errors were not committed, other problems still remain. These refer to the following :

1. Measuring outputs whose characteristics change over time. Some of the associated problems are choice of weighing system, changes in quality levels over time, production of capital goods by the firm for its use, handling of returns from intangible capital outlays.

2. Defining and measuring real capital stocks and 'inputs' as well as labour inputs where characteristics of both factors are diverse and changing.

3. Problems of aggregating heterogeneous units of outputs and inputs.

Consequently, it is difficult to evolve one best index of productivity. The problem is not as severe in manufacturing systems as it is with

service systems, because of relative case of defining and measuring outputs and inputs, in the former,

Some Measures of Productivity

Let us consider a manufacturing system. For evaluating system productivity, several indices could be possible, each relating to the specific input considered. Let

P = production; M = materials; C = capital; L = labour; E = energy;

Then Labour productivity = P/L Energy productivity = P/E

Material productivity = P/M Capital productivity = P/C

Total productivity = P/(L + M + E + C + other factors)

Very often, output per man-hour is used as a measure of productivity. Although this is appropriate for labour productivity, it may not reflect total productivity. Increase in labour productivity need not always imply corresponding increase in total productivity. Holt illustrates this point by considering a situation in which higher labour productivity is achieved by replacement of an old equipment. Holt shows that increase in labour productivity increases the total productivity, but increase in capital cost of new equipment works in the opposite direction and may, if it is large enough, result in decrease of total productivity.

Similar results could be obtained for a multi-product company and for other input factors. In this illustration, productivity is measured as units of output per unit total cost.

A more recent model of total productivity is the Craig-Harris model. In this model, the outputs and inputs are reduced to their base period money value. The input factors are labour, capital, raw materials and other miscellaneous goods and services. For the outputs, the unit sales of each output type allows for adjustments made for new products and quality changes. Labour input includes category-wise base period wages inclusive of fringe benefits. Capital-input factor consists of uniform annual cost of capital for each capital item. The miscellaneous input factor reflects utilities, supplies and purchased services. Merit

of this model is that since input and output values are their base period values, comparison of period-wise productivity is much more meaningful. In addition, of course, it allows for all the inputs. The model, however, has operational problems including the requirement of continuously updated data base.

It is clear that awareness of the need for appropriate productivity indices is growing. This is quite important because programmes aimed at productivity improvement must not operate in conflicting directions to adversely affect the total system productivity.

Improvement of Total Productivity

The principal shortcoming of the models is their diagnostic in capability to identify specific areas in the firm for productivity improvement. In addition, we may not always be able to reduce outputs to their money value. This is specially true in service systems. Besides, in a multi output system, different outputs could necessarily require different productivity indices. Even in a given system, sub-system productivity indices may differ from the system productivity index. How then is consistency achieved in the face of these complex PI requirements? Is it feasible at all to meet the conflicting requirements of the PI programme? Let us take a look at some of the approaches outlined for PI, In the past.

Ewan Clague, while analysing the causes of overwhelming American superiority in productivity of most industries over Europe, lists a number of circumstances leading to this. In summary, they relate to

1. Development of mass market and mass production systems.
2. Willingness to change.
3. Rapid development and continued growth of dynamic professional management.
4. Worker participation and initiative.
5. Participation of industrial engineers in planning and organising for efficient, low cost, high productivity output for mass market.
6. Large scale advertising for building and shaping consumer requirements.

In a systematic analysis, Gottlieb mentions thirty-eight different factors which affect productivity.

It is interesting to note how people in factory look at productivity improvement. For instance, in case of electronics manufacturing, Parkhurst puts emphasis on 'built-in efficiency' of operations combined with effective supervision for greater productivity. In the field of contracting for Weapons Systems Development, Mcarthy stresses development of competent team of design and production personnel, development of advance machinery to handle new exotic materials, development of most efficient facility complex. Looking at the light manufacturing industry, Trumbull sees two factors as very important for increasing productivity and reducing costs : (1) establishment of good measure of productivity; (2) installation of most capable foremen. In case of refinery operations, Brown stresses that productivity must be defined in terms of the entire manufacturing objective. To think in restricted terms of 'cost reduction' and 'forfeit 'profit improvement, to stress 'manpower elimination' rather than 'manpower utilisation' could be disastrous. Definition should cover integrated activities of the company. Methods used to achieve the integrated, multi-dimensional improvement include process analysis, mechanical analysis, organisation and work methods analysis, operation analysis and planning.

John Morrissey's view expressed while looking ahead to the challanges posed by the seventies makes interesting reading. He stressed that greater productivity did not mean greater physical effort. One worked 'smarter' instead of 'harder' for this. He advocated the following three-step approach for higher productivity.

1. Understanding of employees attitudes and perceptions of service.
2. Motivating people towards improvement.
3. Blending together findings of F. W. Taylor, Gilbreths and their successors with those of Herzberg, Meleland, Likert and others.

Donald Burnham, then Chairman of Westinghouse Electric Corporation echoed the same views. He singled out improvement of methods, facilities, procedures and human motivation in all areas of work as principal means of achieving higher productivity. His three-step productivity programme entailed. (1) Massive and continuous research

and development to get facts we do not yet have. (2) Concerted effort to remove any of the road blocks and restrictions to productivity improvement. (3) More time, money and evangelistic effort into the positive encourgement of productivity improvement.

The above is an adequate, representative sample of approaches suggested for the productivity improvement. There appears to be consensus that a productivity improvement programme must primarily involve

1. Choice of appropriate measure of productivity.
2. Improvement of methods, facilities, procedures.
3. Improvement of human motivation in all areas of work.

Systems Approach to Productivity

Parkhurst's emphasis on the built-in efficiency of operations appears quite significant to the author. A given type of operating system, whether it is a job type operating system, flow type of operating system, and so forth, necessarily imposes inherent limitations to be productivity leave attainable. Consider, for instance, the high volume line type manufacture versus the low volume job shop manufacture; a small retail store in the country side versus a departmental store in a large metropolitan city; a large urban hospital versus a rural dispensary and so forth. Thus requirement of productivity higher than achievable by a given system, requires the creation of 'total change' instead of 'modification' in the operating system itself. Productivity improvement programme cannot ignore the underlying characteristics of the operating system. Hence the need to adopt systems approach to productivity. We call this System Productivity'. Such an approach merits serious consideration. It would assist in (1) Establish interrelationship between subsystem productivities. (2) Their effect on system productivity. (3) Identify critical subsystem and components for productivlty improvement. Outline of a possible approach is given in figure 1.

The approach outlined starts with determination of productivity indices of components and subsystems. Next the relationship between system, sub-system and component productivity is determined, with a view to identify subsystems and components critical to PI. Decision then needs

to be made whether a 'total change' in component/s, subsystem/s and the system is necessary. If necessary, search for alternatives is carried out. If this leads to the availability of suitable alternatives, a choice is made. In the opposite case, the feasibility of new design is explored. If feasible, the new design is adopted. If not feasible, a downward revision in PI is made and the process repeats. In case a modification is found adequate, the PI is achieved through improvement of methods, procedure, facilities, improvement of human motivation, improvement of planning and control.

The most important problem with the operational use of the model seems to be the determination of relationships between system, subsytem and component productivity. What for instance, is the relationship of the stores productivity with the outpatient department productivity in a hospital ? Many of such relationships are apparently unknown at the present moment. Continuing research is called for towards the understanding of these. System simulation apprears to be a strong possibility here.

Service Systems

A systems approach is all the more desirable in case of service systems. The productivity of service systems like, for instance, hospitals, is heavily dependent on their operating characteristics. There is continuing shift of emphasis towards such systems because ever increasing volume of manpower input is being absorbed there compared to manufacturing systems. A low productivity of service systems can and often is a cause for social concern. It is therefore the present day challenge to management and productivity specialists alike. Here the complexity of problems inherent might start with the very measure of productivity.

How does, for instance, one measure productivity of a retail store ? What about a policeman-number of arrests per man hour ? A Weather Bureau-number of typhoons tracked ? A Librarian—number of books issued ? A Hospital—number of patients healed ? A Government Office-number of circulars issued ? So forth. The output of such systems is service of some kind. Are the services always quantifiable ? If not what can be done ? What about the quality of service ? Is quality definition even as specific as in their manufacturing counterparts ? Best

of productivity programmes would prove disastrous if inappropriate productivity indices are used. We are only too aware of the 'Mckenser Madness' that put the West Carolina University on the rocks—a gothic horror which helped create total chaos. The best of systems may grow in unwanted fashion, if productivity indices untied to the objectives are used. Often these show up in deteriorating quality of outputs. Specially so, in service systems where controls on service quality are not always either definable or readily possible. The service system productivity improvement programmes might demand revolutionary changes in traditional techniques and methods, revolutionary new concepts in system design. Evidence of this is the 'Word Processing Centre' concept of an office, 'Health Maintenance Organisation,' HMO concept of a hospital, and so forth. In many cases, human input is the prime input of such systems. This makes them even more special.

In this context, it is inevitable that 'Operations Management' would have to play a significant role. Indeed, 'system productivity of operations' could well provide the 'operations management,' its philosophy that so far appears missing. This philosophy will call for a reorganisation of the manager's or the management student's training in this function, with increasing emphasis in the 'Systems Productivity of Operations'. And that reorganisation will call for greater focus on service systems that for far too long have remained largely unnoticed.

Productivity and Management

Looking ahead, improvement in productivity of systems and specially of service systems, is bound to be inevitably amongst the top national priorities, presenting dynamic new challenges to their management.

That situation will demand tomorrow's manager at all levels to be far more productivity conscious than ever before. Given this scenario, productivity will concern all levels of management, specially the operations manager whose concern, it is bound to be the most.

Conclusion

Lastly, the following conclusions emerge from the above discussions:

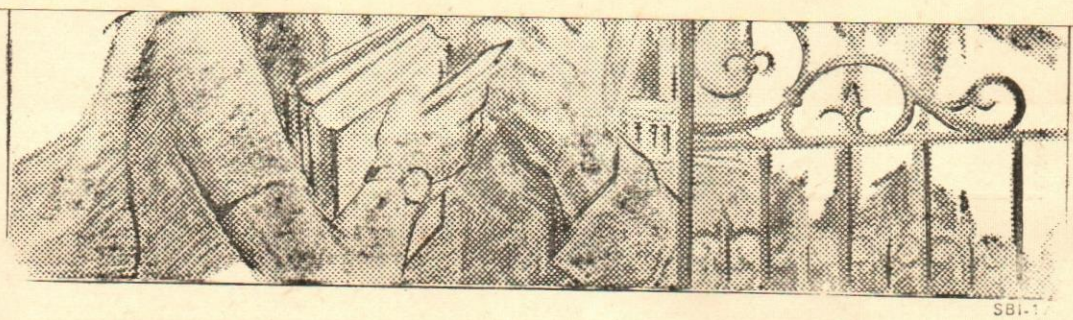
1. A system approach to productivity is suggested in this paper. Such an

approach would help determination of inter-relationships of subsystems productivities and indentify components and subsystems critical to the system productivity. Research needs to be performed to understand the theoretical and/or empirical relationships between these.

2. In a productivity improvement programme, the choice of appropriate productivity index is important. Such an index should avoid overly simplistic measures of output and suboptimisation, relate output to inputs and relate output to system objectives. The programme would have to identify whether total change' or 'modification' is called for in the system, subsystem or any of its components. The former would involve evaluation and choice from amongst alternative designs and even creation of new designs If 'modification's is called for, then productivity improvement would. primarily involve improvement in methods, facilities and procedures, improvement of human motivation and improvement of planning and control within the existing system, subsystem and/or its components.

3. There is immediate need felt for a systematic study and research in productivity improvement of service systems. This is particularrly important because growing volume of manpower input is being absorbed in such systems. At the same time, the usual problems of index definition and so on, assume multidimensional complexity in such systems.

4. A situation wherein higher productivity is a national priority would require the manager specially the operations manager to be highly productivity conscious. That suggests a need for reorganisation in the manager's training of this function, with major emphasis on 'systems productivity of operation's specially of service systems.



Behavioural Sciences and Organisational Change

N. K. Sethi*

Change plays an important role in the dynamics of organisational behaviour. According to B. J. Kolasa "We may not recognise it or otherwise be cognizant of it; we may oppose it or we may even try to accelerate it. No matter what our position may be, change makes its course in the evolution of human effort. Change may take place so slowly that it is not perceptible in one generation or even two or it may occur with such rapidity that we are left somewhat breathless in the wake of waves."[1]

Change is the dominant characteristic of modern society and this is more evident in its organisations. All present organisations are swinging from the external and internal forces of change.

External Forces of Change

External forces of change can be categorised into three broad areas :

1. the highly competitive market place in the private, and also in many respects the public sector of the economy.
2. the accelerating rate of technological advance.
3. the highly volatile changes that are occurring in both th2 physical and social environment.[2]

In order to remain competitive, organisations must construct ahead on all three fronts. They cannot compete in today's market place by standing still or going backward. Technological impact on organisations has

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1. B. J. Kolasa, Introduction to Behavioural Science for Business, John Wiley & Sons, Inc. New York, 1969, p. 348.
2. J. H. Donnelly, Jr., J, L. Gibson, and J. M. Ivancevich, Fundamentals of Management, Business Publication Inc., Austin, Texas, 1971, pp. 234-235.

2. Economic—people, especially in the lower levels, are afraid of a possible economic loss. Being replaced by machine is a real threat to most workers. Today with the increasing use of the computer, many middle managers are also beginning to experience the same fear.

3. Socio-psychological— refers to perceptual, emotional and cultural barriers to change. Perceptually wrong interpretations of the change may lead to resistance. Persons may reach emotionally to a change by bringing fears and prejudices to the surface. Person facing change in an organisation are influenced by their cultural values wich they bring to the situation with them.

Four General Goals to which Management of Change Should be Aimed

1. to improve the means for satisfying somebody's economic wants
2. to increase profitability
3. to promote human work for human beings
4. to contribute to individual satisfaction and social well-being.[7]

Emergence of the Action Role

Nowadays, people would notice that there may not be many professors working in their respective fields, but they can be found almost everywhere else : in factories,[8] in the government,[9] in underdeveloped countries,[10] in backward areas of the United States,[11] in mental hospitals,[12]

7. Ibid. p. 54.
8. C. Argyris, Interpersonal Competence and Organisational Effectiveness, Dorsey Press, Homewood Ill., 1962.
9. H. G. Barnett, Anthropology in Administration, Row, Peterson, and Company, Evanton, Illinois, 1956.
10. G. M. Foster, Traditional Cultures and the Impact of Technological Change, Harper & Row, Publishers, Inc. New York, 1962.
11. S. T. Kimball, The Tallagəda Story, University of Alabama Press, 1954.
12. A. H. Stanton and M. S. Schwartz, The Mental Hospital, Basic Book Publishers, New York, 1954.

in jobs concerned with international matters,[13] and in educational systems.[14] They are advising, counseling, researching, recruiting, developing, consulting, training and working for the widest variety of clients imaginable. This would indicate that the academic intellectuals has become engaged with spheres of action in greater numbers, with more diligence, and with higher aspirations than at any other time in history.

The behavioural sciences have been directly implicated in this trend. Recent additions to the vocabulary of the behavioural scientists which can be said to reflect this trend are the following : clinical sociology, policy sciences, action research, action anthropology, change-agents, special catalysts, human and social engineers, sociotherapy, milieu therapy, and knowledge centres. The primary professional associations of psychology, sociology and anthropology have been devoting more and more time to the problems of application and utilisation. There has also been a growing literature on planned social change through the uses of behavioural sciences."[15]

Finally, a more subtle trend can be detected—a growing concern with normative planning, with new forms of social architecture, with vivid and realistic utopias, with more radical assumptions about social value.[16] These signs and activities all point in the same direction : towards an emerging action role for the behavioural scientist.

Some Reasons for the Emergence of Action Role

1. The causative factors bound up in the warp and woos of our times and age what is called the Zeitgeist. A shift in the intellectual climate of opinion aroused by the threat of atomic destruction and reinforced by the exigencies of our time. More and more behavioural scientists are

13. O. Klineberg, The Human Dimension in International Relations, Holt, Rinehart and Winston Inc., New York, 1964.

14. M. P. Miles, Innovation in Education, Bureau of Publications, Teachers College, Columbia University, N. Y. 1964.

15. W, G. Bennis, A New Role for the Behavioural Sciences : Effecting Organisation change, Administrative Science Quarterly, Vol. 8, pp. 125-165, 1963.

16. J. Friedman, Issues in Planning-Theory, Massachusetts Institute of Technology, Cambridge, Massachusetts 1963.

committed to action programmes and research projects of significance, pertaining to war and peace, problems of Negro-White relations, problems of economic development, etc. So there seems to be a growing disenchantment with the moral neutrality of the scientists and a willingness to rick scientific method on urgent social problems.

2. General tendency to regard the applied social sciences with less condescension.

3. Third reason is simply that we know more. Since World War II we have obtained large bodies of research and diverse reports on application. We are today in a better position to asses results and potentialities or applied social science.

4. Bureaucracy—managers and practitioners, on one hand and organisational theorists and researchers, on the other hand, are dissatisfied with the current practices or organisational behaviour and are searching for new forms and patterns of organising work.

The Notion of Planned Change

Planned change is a method which employs social technology to solve the problems of the society. The method encompasses the application of systematic and appropriate knowledge to human affairs for the purpose of creating intelligent action and choices. Planned change aims to relate to the basic discipline of the behavioural sciences as engineering does to the physical sciences or as medicine does to the biological discipline. Planned change can be viewed as a linkage between theory and practice, between knowledge and action. It plays this role by converting variables from the basic discipline into strategic instrumentation and programmes. Historically, the development of planned change can be seen as the resultant of two forces : complex problems requiring expert help and the growth and viability of the behavioural sciences. The process of planned change involves a *change agent*, who is typically a behavioural scientist brought in to help a *client system*, which refers to the target of change. The change agent in *collaboration* with the client-system, attempts to apply *valid knowledge* to the client's problems. These four elements in combination, change-agent, client-system, valid knowledge, and a deliberate and collaborative relationship—circumscribed the

class of activities referred to as *planned change*.

It may further help in defining planned change to compare it with another type of deliberate change effort, Operations Research. Both planned change and operations research are World War II products; both are problem centred. Both emphasise improvement and optimisation of performance. To that extent, they are normative in their approach to problems; that is, they attempt to maximise goals under certain conditions. Both rely heavily on empirical science. Both rely on a relationship with clients based on confidence and valid communications. Both emphasise a system approach to problems meaning an awareness of the interdependencies within the internal parts of the system as well as boundary maintenance with its environment. Both appear to be most effective when working with systems which are complex, rapidly changing and probably science-based.

Perhaps the most crucial difference between operation research and planned change has to do with the identification of strategic variables, that is with those factors which appear to make difference in the performance of the system. Planned change is concerned with such problems as identification of mission and values, collaboration and conflict, control and leadership, resistance and adaptation to change, utilisation of human resources, communication and management development. Operation Research practitioners tend to select economic or engineering variables which are more quantitative, measurable, and linked to profit and efficiency. Ackoff and Rivett, for example, classify operation research problems in the following ways :[17]

inventory	queuing	routing	competition
allocation	sequencing	replacement	search

A second difference has to do with the perceived importance of the relationship with the client. A third major difference is that operation research practitioner devotes large portion of his time to research, to problem solving. The change agent tends to spend somewhat more time on implementation through counselling, training, management development schemes and so forth. The fourth major difference, planned agent tends to take less seriously the idea of the system in their approa-

17. R. L. Ackoff and R. Rivett, A Manager's Guide to Operation Research, John Willey & Sons, Inc., N. Y. 1963.

ches. Finally, the idea of an interdisciplinary team, central to operation research, does not seem to be a part of most planned change programme.

Lack of a Viable Theory of Social Change

Unfortunately, no viable theary of social change has been established. Indeed it is a curious fact about present theories that they are strangely silent on matters of directing and implementing change. The present theories tend to explain the dynamic interaction of a system without providing one clue to the identification of strategic leverages for alteration. They are suitable for observers or social change, not for practitioners. They are theories of *change* and not of *changing*.

According to Robert Chin (1961, 1963)[18] a theory of changing must do the following (prerequisites) :

1. a theory of changing must include manipulable variables accessible levers for influencing the direction, tempo and quality of change and improvement.
2. the variables must not violate the client system's values.
3. the cost of usage cannot be prohibitive.
4. there must be provided a reliable basis of diagnosing the strength and weakness of conditions facing the client system.
5. phases of intervention must be clear so that the change agent can develop estimates for termination of the relationship.
6. the theory must be communicable to the client system.
7. it must be possible to assess appropriateness of the theory for different client systems.

Such a theory does not exist now, and this explains why so many change programmes based on theories of social change have been inadequate.

18. R. Chin, Models and Ideas About Changing, Paper given at Symposium on Acceptance of New Ideas, University of Nebraska, 1963,

Eight Types of Change Programmes

1. Exposition and propagation—the most popular type of change programme. It rests almost entirely on the assumption that knowledge is power, that ideas change the world and the men who possess "truth" will ultimately lead the world.

2. Elite corps—programmes grow from the realisation that ideas by themselves do not constitute action and that a strategic role is a necessity for Ideas to be implemented.

3. Human relations training—programmes are similar to the elite corps idea in the attempt to translate behavioural science concepts in such ways that they take on personal reference for men in power positions.

4. Staff—programems provide a source of intelligence within the client-system as in the work of social anthropologists advising military governors after World War II. The strategy of the staff idea is to observe, analyse, and to plan rationally.[19]

5. Scholarly consultation, as defined by Zetterberg,[20] includes exploratory inquiry, scholarly understanding, confrontation, discovery of solutions, and scientific advice to client.

6. Circulation of ideas—to the elite builds on the simple idea of Influencing change by getting to the people with power or influence.

7. Development research—has to do with seeing whether an idea can be brought to an engineering stage. It is directed toward a particular problem, not necessarily a client, and is concerned with implementation and programme.

8. Action research—termed by Kurt Lewin, undertakes to solve a problem for a client. It is identical to applied research generally except that in action research the roles of researcher and subject may change and reverse, the subjects becoming researchers engaging in action steps.

19. G. Myrdal, Value in Social Theory, Harper & Row Publishers Incorporated, New York 1958
20. H. Zetterberg, Social Theory and Social Practice, Bedmister Press, New York, 1958

These eight programmes, while differing in objectives, values means of influence, and programme implications, are similar in wanting to use knowledge to gain some socially desirable end. Each seems successful or promising; each has its supporters and its detractors. Because of these, there are four visible biases that would probably weaken the full impact of these eight change programmes. They are :

1. Rationalistic Bias: No implementation Program. Most of the strategies rely almost totally on rationalatity. But knowledge about something does not lead automatically to intelligent action. Intelligent action requires commitment and programmeas as well as truth.

2. Technocratic Bias : No Spirit of Collaboration. Change typically involve risk and fear. Any significant change in human organisation involves rearrangement of patterns of power, association, status, skills, and values. Some may benefit, others may lose. Thus change typically involves risk and fear. Yet change efforts sometimes are conducted as if there were no need to discuss and "work through" these fears and worries.

3. Individualist Bias : No Organisation Strategy Involved. This refers to strategies which rely on the individuals while denying the organisational forces and roles surrounding him. This is, however, simply no guarantee that a wise individual who attains power will act wisely. It may be that role corrupts—both the role of power and the role of powerlessness. In any event, there is no gaurantee that placing certain types of people in management—or training them or psychoanalysing them or making scientist of them—leads to more effective action. Scientists act like administrators when they gain power.

4. Insight Bias : No Manipulability. Insight leads directly to sophistication in rearranging social systems or making strategic organisation interventions. Insight provides the relevant variables for planned change as far as personal manipulation goes, but the question remains : How can that lead directly to the manipulation of external forces ?

Elements of Planned Organisation Change

There are three elements of planned organisational change, namely : (1) change-agents (2) change programmes (3) strategies.

Change Agents : The New York Times, in its October 7, 1963 edition printed an advertisement announcing a search for "change-agents." It defined change-agent as a result oriented individual able to accurately and quickly resolve complex tangible and intangible problems. Energy and ambition necessary for success. W. Bennis defined change-agents as professionals who, for the most part, hold doctorates in the behavioral sciences. They are not very homogeneous group, but they do have some similarities. They are alike in that they take for granted the centrality of work in our culture to men and women in highly organised instrumental settings; in their concern with improvement, development, and measurement of organisation effectiveness; in their preoccupation with people and the process of human interaction; in their interest in changing the relationships, perceptions and values of existing personnel.

Change Programmes: Three broad types of change programmes that seem to be most widely used : (a) training (b) consulting (c) applied research.

TRAINING : term used to describe a particular variety of training which has been called "laboratory training" sensitivity of group dynamics training, and the most commonly "T" group training.[21]

The idea of laboratory training orginated at Bethel, Maine in 1947 under the guidance of Bradford, Benne and Lippitt, all of whom were influenced by Kurt Lewin. This group shared a common concern for the application of the behavioural sciences to practice and policy. The T group emerged as one of the most important components of laboratory training and has evolved over the past eighteen years into one of the main instruments for organisation change.

T groups are used in organisations today in the following ways ;

Strange labs : executives from organisations attend labs as "delegates" representing their organisations. The parent organisation hopes to improve the organisation this way by seeding a sufficient number of managers.

21. R. R. Blake, J. S. Mouton, L. B. Barnes, and L. E. Greiner, A Managerial Grid Approach to Organisation Development : The Theory and Some Research Findings *Harvard Business Review*, Vol. 42, 1964.

and L. E. Greiner.

2. A recapitulation by C. Argyris of a change programme used by New York headquarters team of a large oil company to improve the functioning of one of its smaller refineries in New England.[22]

Managerial Grid : Figure 1 shows the grid of locating types of managerial strategies. G. R. Blake and his colleagues developed a change programme based on the analytic framework of managerial styles. On the basis of this twofold analytic framework, it is possible to locate five types of managerial strategies.

One dimension is "concern for people; "the other is "concern for production." The term concern for as used here represents the degree of concern for, not the actual production of, people's activities. Blake and his colleagues attempt to change the orgnisation in the direction of "team management" (9,9 or high concern for people and high concern for production). Based on experience with 15 different factors, the Blake strategy specifies six phases :

1. off-site laboratory for diagonal slice of personnel
2. off-site programme focused on team training for "family groups."
3. training in the plant location designed to achieve better integration between functional groups.

22. C. Argyris, Organizational Development, Yale University Press, New Haven Connecticut, 1960.

Cousin lab : Organisations set up labs for individuals with similar organisational ranks but from different functional groups, e.g., all first line supervisors or all general foremen.

Diagonal slices : T groups are composed of members from the same company but of different ranks and from different departments. No man is in the same group with anyone from his own work group.

Family of functional groups—these groups are indentical to the intact group as indicated by the formal organisation, e.g., a particular supervisor would be with his work group.

CONSULTING for every type and style of training, there is an equivalent type of consulting. The consultants start from the chief presenting symptom of the client, articulates it in such a way that the causal and underlying mechanisms of the problem are understood, and then takes remedial action. He employes an extensive reportory of instrumentation which he uses as flexibly as possible. Using himself, most of all, he

4. goal setting sessions for groups of 10 to 12 managers.
5. implementing the plan to help the organisation realise the goals established in phase 4
6. stabilising the changes brought about during the prior phases.

Blake and his colleagues estimate that the time required for the first four phases, appreciation sessions, team training, horizontal linking and setting of organisation goals may be two years or longer. The next two, implementing plans and stabilising changes, may require an additional two years.

Elements in one-year Programme Refeinery : Figure 2 (Argyris, 1960) presents another strategy : a change programme used in a large oil company to improve the functioning of one of its smaller-refineries. A new manager was named and sent to a T-group training sessions to gain awareness of the human problems in the refinery. The Headquarters Organisational Development staff then conducted a diagnosis through a survey and interview of the managerial staff (70) and a sample of hourly employees (40/350). It was decided that a laboratory programme of T groups might be effective but premature, with the result that weekly seminars that focused on new developments in human relations were held with top management about (20). A one-week laboratory training programme followed for all supervisors in diagonal slices and then another re-evaluation of needs was undertaken. Some structural innovations were suggested and implemented. During the last phase of programme the Scanlon Plan was adapted and installed.

Though it cannot be said with any assurance that these two strategies are typical, it may be helpful to identify certain features:

1. length of time—Blake's estimate of 5 years.
2. variety of programmes utilised—research, consulting, traning, teaching planning.
3. necessity of cooperation with top management and the parent organisation.
4. approaching the organisation as a system rather than as a collection of individuals.

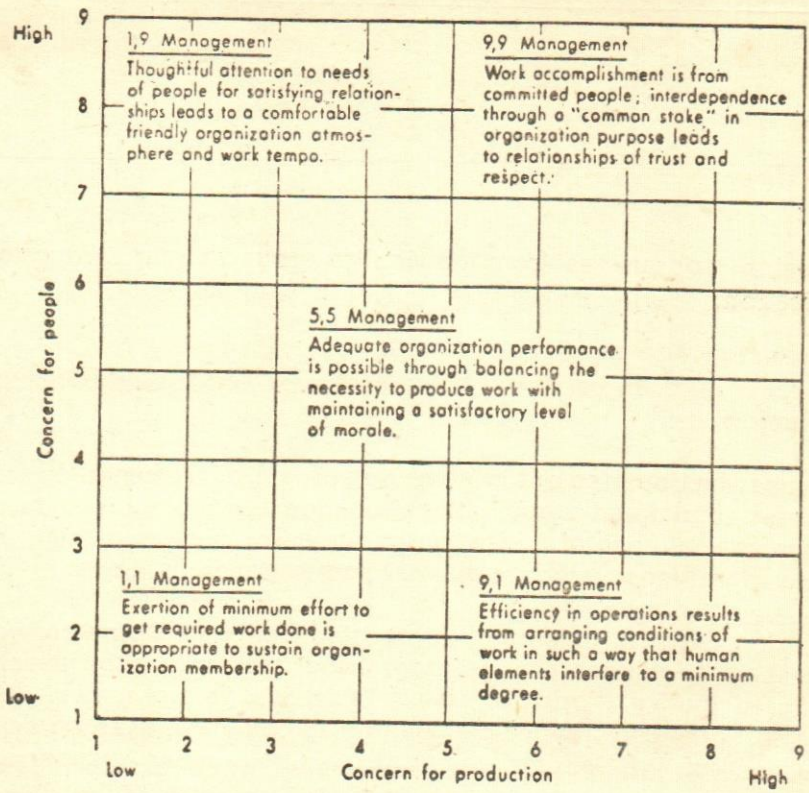
High
Low
Concern for people
1,9 Management
Thoughtful attention to needs of people for satisfying relationships leads to a comfortable friendly organization atmosphere and work tempo.
9,9 Management
Work accomplishment is from committed people; interdependence through a "common stake" in organization purpose leads to relationships of trust and respect.
5,5 Management
Adequate organization performance is possible through balancing the necessity to produce work with maintaining a satisfactory level of morale.
1,1 Management
Exertion of minimum effort to get required work done is appropriate to sustain organization membership.
9,1 Management
Efficiency in operations results from arranging conditions of work in such a way that human elements interfere to a minimum degree.
1 2 3 4 5 6 7 8 9
Low
Concern for production
High

Fig. 1

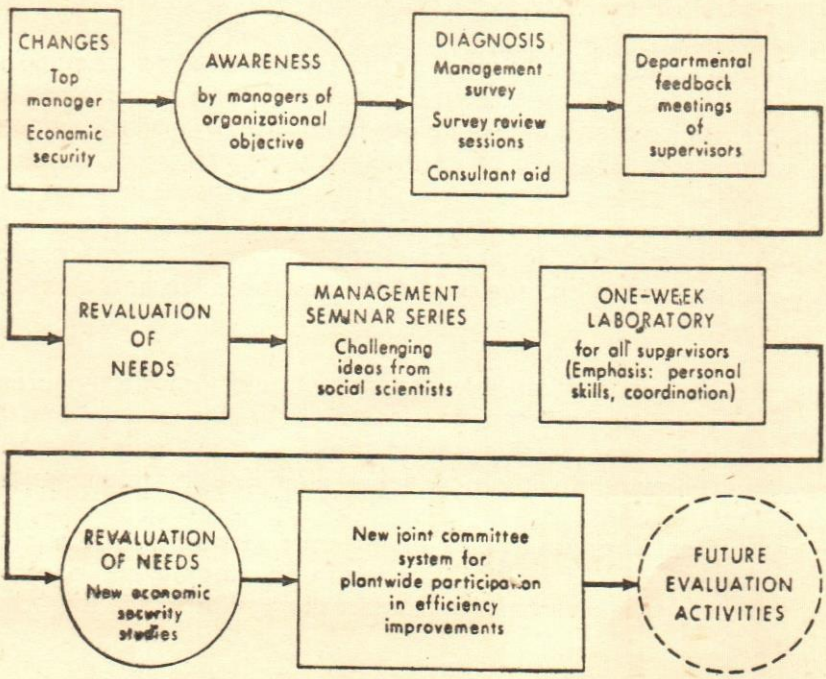
CHANGES
Top manager
Economic security
AWARENESS
by managers of organizational objective
DIAGNOSIS
Management survey
Survey review sessions
Consultant aid
Departmental feedback meetings of supervisors
REVALUATION OF NEEDS
MANAGEMENT SEMINAR SERIES
Challenging ideas from social scientists
ONE-WEEK LABORATORY
for all supervisors (Emphasis: personal skills, coordination)
REVALUATION OF NEEDS
New economic security studies
New joint committee system for plantwide participation in efficiency improvements
FUTURE EVALUATION ACTIVITIES
HEIGHT ADJUST SCREW
STOPPER SCREW

Fig. 2

5. phasing programmes from individul to group to inter group to overall organisation.

6. intellectual and emotional content.

Conclusion

This paper has pointed out in some details the background, elements and processes of planned organisational change and placed it in its perspective as a special case of utilisation of social knowledge. It may be useful to state in the most tentative manner some generalisations.

First, a forecast. It has been forecasted that we will see an increase in the number of planned change programme toward less bureaucratic and more participative, "open system" and adaptive structures. Given the present pronounced rate of change, the growing reliance on science for the success of the industrial enterprise, the growing number of professionals joining these enterprise, and the "turbulent contextual environment" facing the firm, we can expect increasing demand for social inventions to revise traditional notions of organised effort.

As far as adoption goes, it requires that the type of change should be of proven quality, easily demonstrable in its effects, and with information easily available. Its cost and accessilbility to control by client-system as well as its value accord have to be carefully considered.

As far as acceptance is concerned, it also depends on the relationship between the change agent and client system. The more profound and anxiety-producing the change, the more collaborative and closer relationship required.

With respect to implemantation, this process should include the creation of understanding and commitment towards a particular change and devices whereby it can become integral to the client systems' operations. In summay, the following are the necessary elements in implementation:

1. The client system should have as much understanding of the change and its consequences, as much influence in developing and controlling the fate of the change, and as much trust in the initiator of the change as is possible.

2. The change effort should be perceived as being self-motivated and voluntary as possible.

3. The change programme must include emotional value as well as cognitive (informational) elements for successful implementation.

4. The change agent can be crucial in reducing the resistance to change. As long as the change agent acts congruently with the principles of thd programme and as long as the client has a chance to test competence ano motives, the agent should be able to provide the psychological support so necessary during the risky phases of change.

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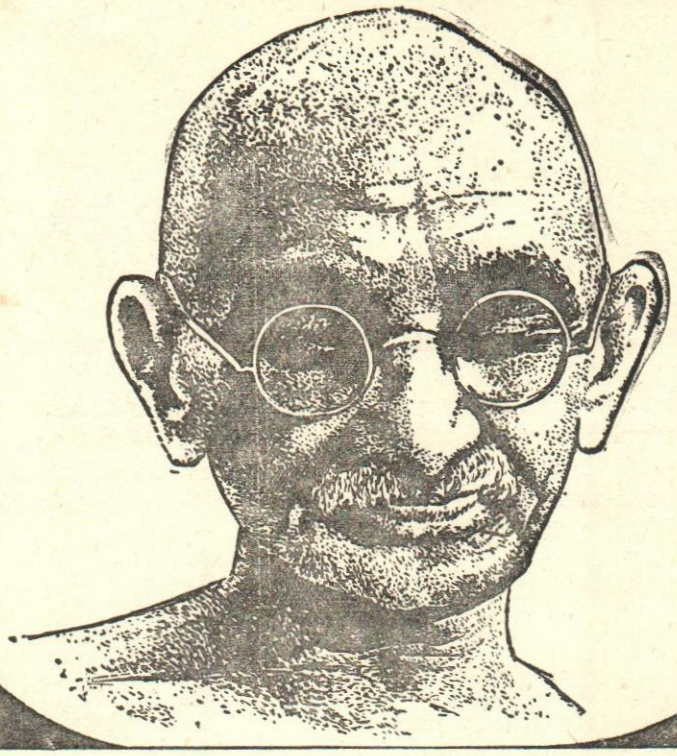

"Much of the deep poverty of the masses is due to the ruinous departure from Swadeshi in economic and industrial life."

—MAHATMA GANDHI

be Indian, buy Indian

Suggestion Schemes : Analysis of a Survey

N. V. Krishna* Baljit Singh**

In order to build better morale, bring about a sense of participation, and improve the functioning of the organisation, it is necessary that the management provide an opportunity for the employees to make suggestions. The reasons that underlie the use of employees suggestions system are :

i) the employee closest to the job is perhaps the best person to suggest changes for improving performance.

ii) It utilises the abilities of all the workers to the fullest extent by encouraging them to make suggestions and rewarding them for the ideas on the basis of their value.

There are a number of organisations in India, having some forms of suggestions systems operating. A project was undertaken to collect the Suggestion Schemes prevailing in various industrial units in U.P and M.P. The idea was to collect relevant information with regard to the schemes in existence, analyse the same and then disseminate the information so as to help other organisations to take advantage of it.

Questionnaires were circulated among 50 selected industries in U. P. and M. P., 15 of which were public undertakings and others private. No reply was received from 25 units despite a reminder. Out of the 25 units which responded, 12 expressed that they did not have any Suggestion Scheme. However, they were eager to start one and wanted information for the same. Details of schemes were received from 12 units, 5 of which were from the public sector. It would be noticed that 20% of the private sector units and 34 percent of the public sector units sent their schemes.

The sample (12 schemes) available for analysis has been very small.

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**Assistant Director, National Productivity Council, Kanpur.

However, they have been broadly analysed on the basis of the following factors:

1. Year of commencement of the scheme
2. Objectives
3. (a) Procedures for receiving suggestions
   (b) Coverage and
   (c) Time lag in sorting and processing, etc.
4. Publicity media
5. Evaluation procedure.
6. Percentage of workers giving suggestions
7. Percentage of suggestions accepted
8. Monetary benefits accrued
9. Awards given
10. General difficulties,

General Analysis

Commencement of the Scheme : Out of the 12 schemes, 7 were started in 1960s, and 5 after 1970. There are hardly 3 industries in which the scheme came into existence within a year or two of the establishment of the concern. Most of the units have started the scheme recently after a considerable lapse of time from the establishment of units. In 5 units the scheme has started after 20 to 30 years of the establishment of the concern.

Objectives : The objective of the scheme has been more or less the same in all the organisations with marked emphasis on improvement in working methods, reduction of waste and an overall improvement in efficiency. Only one concern has given priority to suggestions pertaining to accident reduction and improved safety. Another industry has sought to achieve "Improved Industrial Relations and Employees' participation in

company advancement," through the suggestion system.

Procedure : Nearly all the industries have locked suggestion boxes, for collection of suggestions. In some cases suggestions are also forwarded through departmental head or the incharge of the scheme. Only 5 units have prescribed forms for submitting suggestions.

Coverage : The scheme covers all the employees of the factory except in two units where employees in the category of research and those connected with special studies and investigations are excluded. Except two, the rest do not accept oral or anonymous suggestions.

Time : The processing time, on an average is about 2 weeks. In one or two cases it is about 6 weeks. The sorting of the suggestions, however, has wide variations ranging from one week to as high 6 months. In most of the cases, it is about 3 months.

Publicity Media : In almost all the units the scheme is popularised througn notice boards at conspicuous places in factory area such as canteen, the rest room etc. Publicity is also given through house journals, signboards and banners in some of the units.

Evaluation Procedure : In 10 out of the 12 units there is an evaluation committee to screen the suggestions received. The composition of the committee varies from industry to industry. The concerned departmental heads are normally included in the committee in addition to the Works Manager, Chief Engineer, Personnel Officer etc. In two cases the Industrial Engineer is the member of the suggestion committe. Two units have a preliminary screening of the suggestions before being passed on to the committee. Two units do not have any committee but the evaluation is done by the heads of the departments. Only one committee has a worker's representative.

Participation of Workers: The percentage of the employees giving suggestions has been quite low, the lowest being 0.15 percent. The maximum is about 40 percent.

Suggestoins Accepted : The percentage of the suggestions accepted varies very widely. In 5 industries the percentage of accepted suggetions have been about 40 percent and in the rest, it has been very

low, in a few cases as low as less than 1 percent.

Monetary Benefits Accrued : Most of the units have expressed their difficulty in ascertaining the information with regard to the monetary gains accrued from the suggestion scheme. While no monetary benefits have been derived by 3 units, 7 units have indicated their inability to express the benefits in the terms of monetary value because of thn general nature of the suggestions. One private company has been able to drive Rs. 70,000 worth of benefit as a result of the suggestion scheme of which Rs 35,000 has been in one year and Rs. 25,000 as a recurring saving. Another private firm has been able to achieve a savings of Rs 20,000 in one year itself.

Awards : The total amount given as cash award ranges from Rs. 350 In one concern to Rs. 31,000 in another. Photographs, public notices, appreciation certificates, reports in company magazines, have been some of the popular non-financial awards for the good suggestions. Out of the 12 schemes, only one concern has an award scheme based on a fixed percentage of the savings, i. e. 10 percent of the first year's calculated savings and 1 percent of the non-recurring savings. Two other concerns have indicated that the awards are based on the amount of savings to be accrued. It is also worth noting that nearly no award has been given in three organisations.

General difficulties : Some industries have expressed that the workers often complain against fellow workers and against company, instead of giving suggestions. Some companies have also indicated jealously and ill will among fellow workers as a result of which suggestions have been few. This has been so only in those units where the Suggestion Schhme has started very recently. Industries where the scheme has been in existence since long, have, however, not expressed any difficulties. Only two of the units have reviewed the scheme and have been actively revising it.

Conclusion

It would not be advisable to draw any definite conclusion from a small sample size of 12 suggestion schemes. However, the above analysis provides certain useful information and broad indications regarding the

suggestion systems in general. These would be helpful in designing new schemes and modifying the existing ones for achieving better results.

1. Proper planning should precede the introduction of a Suggestion System. The objective should be clearly defined and wide publicity should be given to the scheme within the plant. A fair and just evaluation committee will ensure the proper processing of the suggestions and determination of fair awards.

2. Delay in processing, sorting and in the announcement of the reward may reduce the enthusiasm of the participants and may adversely affect the attitude and interest of other workers towards the scheme.

3. In most of the schemes the participation has been rather low. Good publicity and confidence among workers that the evaluation and awards would be fair will help to boost participation. The award has to be adequate and fair, commensurate with the quality of the suggestion.

4. The scheme should assure the workers that there would be no retrenchment or reduction of work force as result of the implementation of the suggestions. Often workers are reluctant to give suggestions which involve savings in time.

5. In most of the schemes there does not appear to be any pre-determined system for deciding the amount of awards. This would have to be worked out and spelled out clearly.

6. There should also be a system of computing the monetary benefits derived from the suggestions received. This, in fact, could be the basis for deciding the awards. There would, however, be certain cases where determining definite monetary benefits may be difficult but a qualitative system for awards in such cases depending upon the general merits of the suggestion would have to be worked out.

7. Only two units have reviewed the scheme and have been actively revising it. It is necessary to review the working of the scheme, atleast once a year and bring in modifications for improvement if required.

8. The small number of suggestions received indicates that there are very

few units in this region making use of this media of communication for the betterment of the company.

9. A suitably designed Suggestion Scheme, if effectively maintained can help the organisation in several ways. Some of these are : savings to the company, generation of new ideas, and above all providing an effective communication media between the employer and employee, which are all essential for the overall efficiency and growth of the company.

10. A Suggestion Scheme can be an excellent medium for promoting high morale giving employees an interest and enthusiasm for the work and problems connected with it and helping the company to promote efficiency and cut costs. At its worst, it can produce frustration and irritation among employees, and lead to management considering the scheme a complete waste of time.

There are four things that are generally necessary if a scheme is to be successeful in firms of all sizes. These are :

a) Management should be enthusiastic and give it full support.

b) The scheme should be introduced with carefully planned publicity.

c) Awards should be generous.

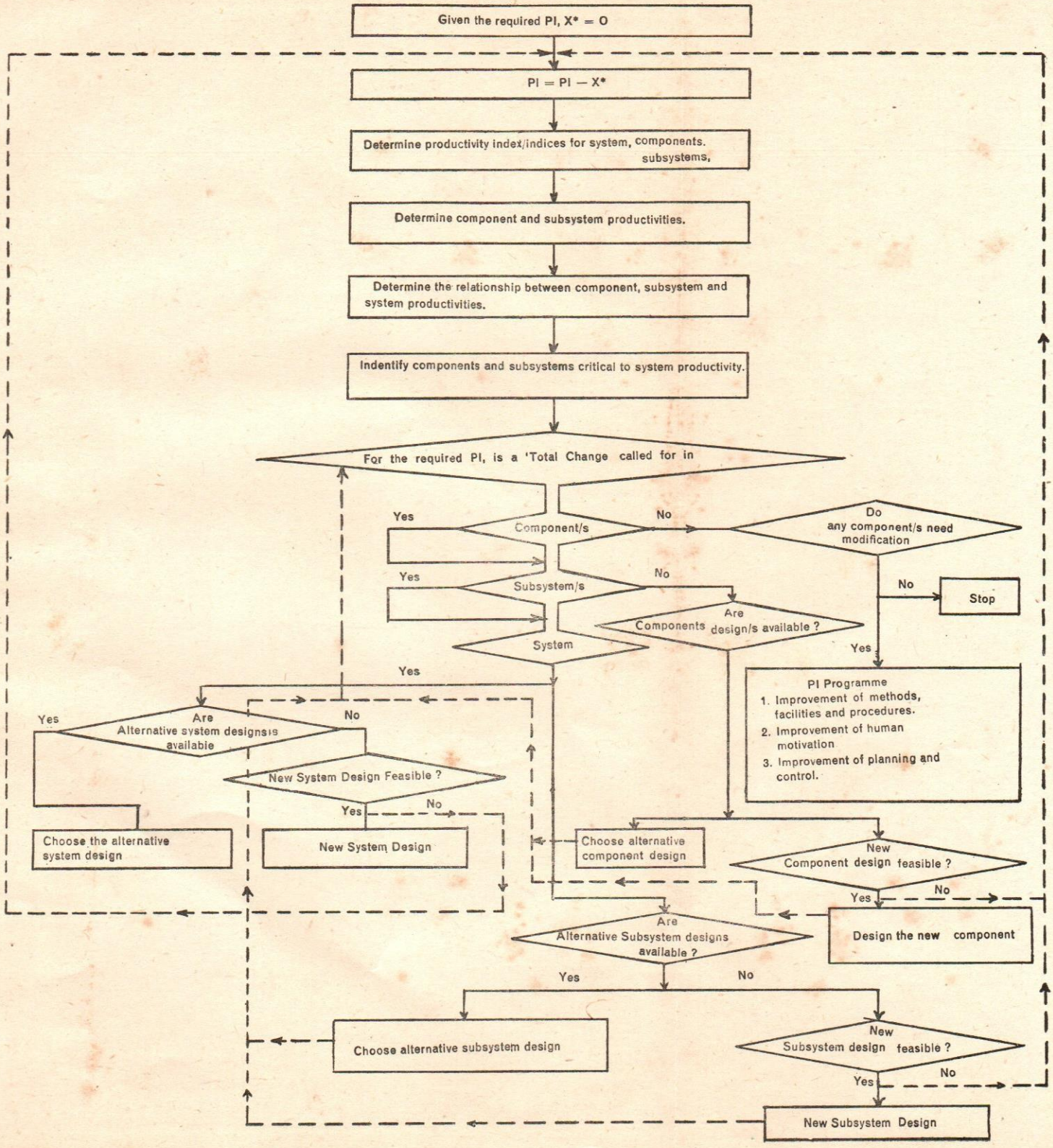
d) Employees should have confidence in the scheme.

11. Where the management itself does not give adequate importance to the Suggestion Scheme, there is no hope of employees taking interest in it. Management will need to submit ideas, and to help them to realise that the scheme is a fair one.

12. A publicity campaign will undoubtedly help to arouse enthusiasm among employees. Constant and changing publicity will be necessary if the interest stimulated by the initial campaign is not to die.

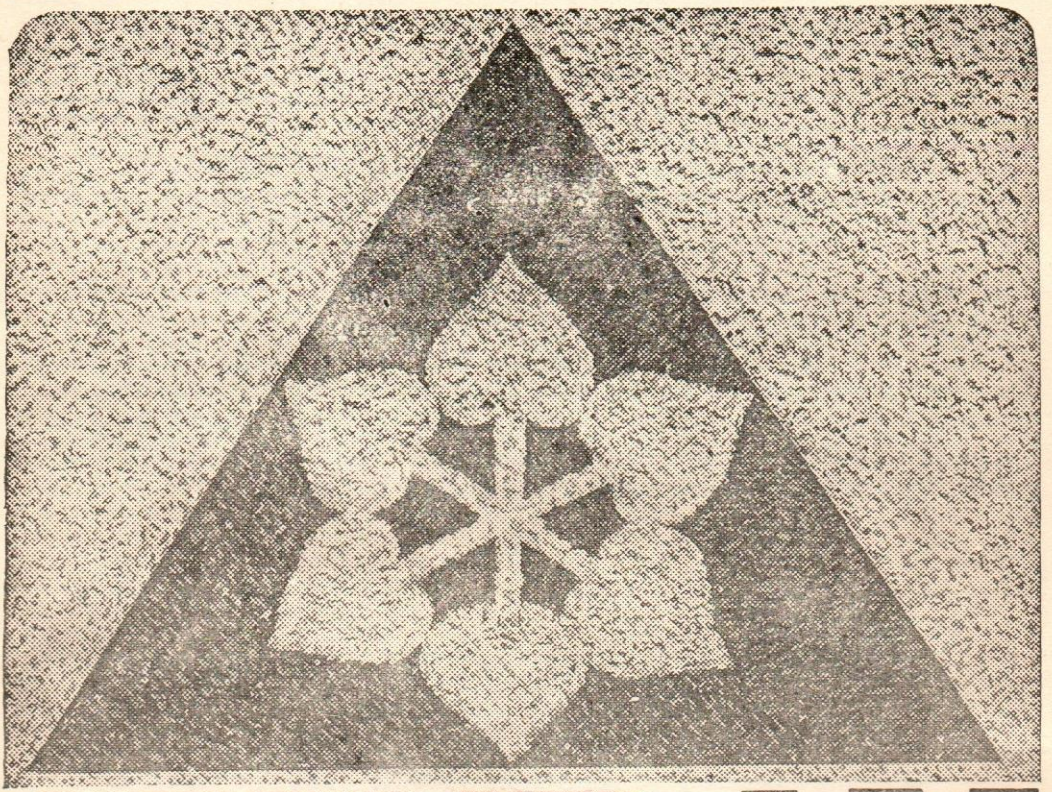
13. It would be a good scheme if awards are also given for suggestions which are good, but which somehow cannot be immediately put into practice. Employees would naturally like to know the rules of a suggestion scheme, and also the criteria for evaluating the schemes. It may be advisable to set up a committee representing the various aspects of the

Figure 1 : **Systems Approach Productivity Improvement**



firm's business. When the committee examines the suggestions complete anonymity with respect to the suggestion may help to ensure impartiality.

14. Prompt and cautious attention by the committee, and a full explanation when an idea is unsuitable will encourage suggestors to try again. The above measures would help to ensure that the suggestion scheme is accepted, and that it works profitably both for the company and for its employees. It is hoped that the information collected from the various organisations, and the analysis given above, would be useful either in improving or introducing suggestion systems. □



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Increase Productivity with Numerical Control Machine Systems

Joseph Stanislao* Karl G. Maurer**

Numerical control machine system can be defined as the control of a process by a series of numerical instructions. Numerical control applied to machine tools offers new potential for various degrees of mechanisation, especially in small batch production (see figure 1). It is a technique which is only twenty years old in the advanced countries, but has mushroomed not only because of the inherent advantages of the system, but also because of the decreased demand it places on skilled labour on the production floor.

Numerical control is finding applications in many fields, including :

(1) Piercing, notching, and pressing; in general, the metal forming tool area. NC promises to make pressing dies unnecessary by using segmented press plates. This has been done successfully on some aircraft parts.

(2) Grinding, riveting, tube bending, and welding.

(3) Testing and inspection, an area of rapid growth of NC since they are a large bottleneck in many companies.

(4) Automatic wiring of circuit boards and soldering of printed circuit components.

(5) NC drafting machines which automatically prepare drawings from data on tape are available. One of their uses is to check designs made by computer systems.

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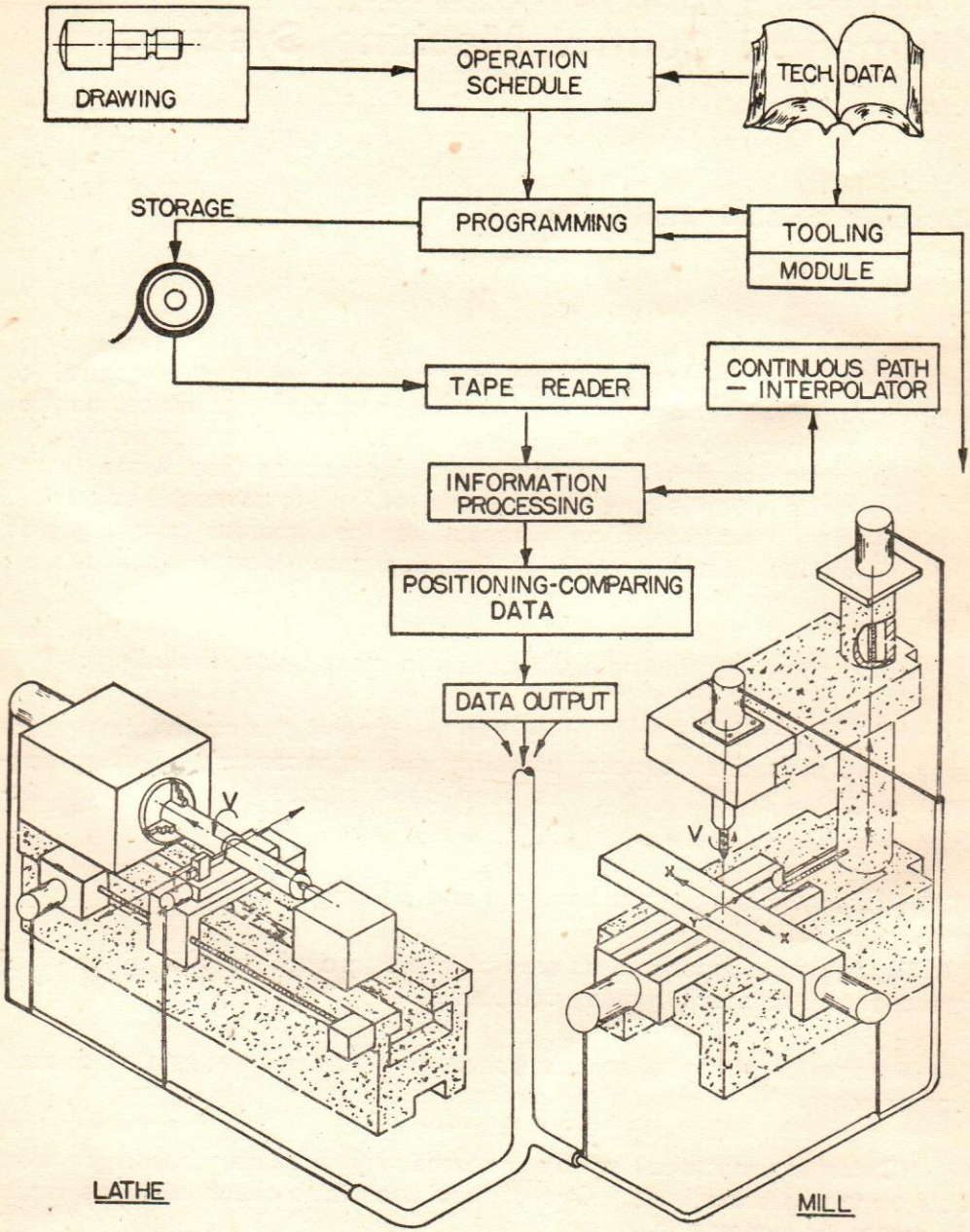

Figure 1 - Numerical Control Systems Used In Standard Machine Tools

Usefullness of NC System

The generally accepted advantages are :

(1) Reduced machining time and direct skilled labour savings. All decisions are pre-determined; no time is lost for checking measurements; optimum machine feeds and speeds can be programmed. Operator fatigue is reduced; less skilled operators can be used; positioning and traversing are generally faster and more reliable.

(2) Tool and fixture savings are frequently quite large. In fact, this is often the largest single source of savings. Instead of a jig or template, travel is completely determined by a programme.

(3) Reduced set-up time is often the result of fewer set-ups. A NC machine tool can be programmed to do more operations in one set-up.

(4) Improved accuracy and repeatability is another principal reason for considering an NC machine system. NC machine tools are generally sturdier and more accurate than their conventional counterparts in order to meet the requirements of the dynamic response of the servo systems. Common tolerance capabilities are positioning accuracy +.025mm, and repeatability+.0127mm.

(5) Increased machine utilisation; for numerous companies, this tops the list of advantages. Conventional machine tools, typically, are actually cutting or machining only 25 percent of the time. With NC many industrial firms find they can aim for about 80 percent machine utilisation. For larger machines and frequent set-ups, this figure is obviously lower.

(6) Reduced lead time, as a cousequence of advantages indicated in part two, has been the main reason for buying NC machine tools in many job shops. Examples of lead time reductions from months to weeks, weeks to days, and days to hours are numerous. This competitive advantage is quite valuable for competition among job shops.

(7) Reduction of inventory and floor space requirements is often an area of great savings. With the reduced lead time of NC, it is no longer necessary to maintain large stores of spare parts; only the tapes

need to be stored. A number of plants have also *either* completely eliminated or significantly reduced their tool storage area.

(8) The flexibility of NC is a point of particular value for most of the smaller metal working facilities. It has been said that NC eliminates the small-lot cost penalty. Changeover from job to job is fast. Minor differences in similar parts or modifications in engineering prototypes can be accomplished by changing the tape instead of using a different jig or fixture.

(9) Reduced in-process inspection costs and less scrap have been experienced by most users. Experience has shown that inspection costs are easily reduced by more than 50 percent. Often, only the first part is inspected. Provided inspection is maintained on the tape, scrap is usally reduced since the accuracy is better and there is less chance of human error.

(10) Management has control of the process. This has been called the "key gain" of numerical control. The job is planned by qualified personnel, and is no longer operator-paced or influenced. Product costs can be predicted with much greater accuracy.

(11) NC forces management to coordinate the entire organisation, the penalty for not doing so is considerable where NC equipment is involved.

With all the advantages of the Numerical Control System, its prevalence is still quite constrained today. The two main reasons usually advanced to explain this are:

(1) Misconceptions and lack of understanding on the part of management

(2) The inadequacy of engineering economy analyses and equipment buying formulas. Because of this, NC often cannot be placed in proper perspective, hence, true and fair, comparisons are not always drawn.

"*NC is automated mass production.*" In reality, it is just the opposite, and has been called "*small-lot-mechanisation.*" The usual lot size is 5-50 parts. Many organisations will programme a lot of one if the part is complex or repeated orders are expected. The maximum is also quite flexible. Lots of more than 200, or even more than 500, are often run on NC. But

NC is not generally considered to be a mass production tool and often cannot compete on large lot sizes where its reduced tool requirements are a relatively insignificant advantage.

"*NC is too expensive and too complex.*" As will be evident to any serious investigator, this is not always true; programming is simple, and low-cost syetems are avilable. Companies in various countries with a labour force as small as 40 reported successful installations of NC equipment. (In some of these cases, the labour force was reported to be not highly skilled).

"*The downtime is excessive.*" This is generally not true. Modern solid state circuitry has greatly improved reliability, and much attention has been paid to facilitating failure diagnosis. It is true that idle time is more expensive; but idleness caused by poor machine scheduling Is not a fault of the system. It is the fault of first line supervision !

Inadequate planning and preparation tops the list of read problems. Production scheduling is quite important. The machine has a work turnover rate of two to three times that of conventional equipment, and careful planning is required to keep the machine loaded. As mentioned earlier, the penalty for making no provisions for this is much higher than with conventional equipment. Detailed planning is therefore necessary for NC systems.

This problem of detailed planning has forced most NC users to review all phases of their organisations; this in turn has often led to improved overall efficiency. Numerical control will have an impact on many facets of the company. It requires cooperation of programming, production control, tool section, inventory control, etc. since all work on a job is done simultaneously, rather than in sequence. Inventory can be smaller but must be controlled more closely since its turnover rate is faster.

It follows that numerical control is likely to prove a disappointment, unless management is fully involved and demands the cooperation of all sections. The NC coordinator must have full management backing in requesting the assistance of all sections, and management must recognise that unusual problems are to be anticipated.

As for the cost of the installation, it is important to realise that it is not

(6) Tape-search facilitates returning to a point where a cut was interrupted due to, for example, breakage of a tool. Most users recommend it.

(7) Test tapes and other facilities for failure diagnosis are of great value.

(8) Mirror-image attachments (for cutting mirror images), reciprocating feed attachments (for chip clearance in deep hole drilling), etc., are options which can be quite useful.

Selection is simplified if commercial tools can be broken down into classes of characteristics. Numerically controlled machine tools can be classified in several ways, all of which are important to management.

(1) Mode of movement required of the machine,
(2) Number of axes under NC,
(3) Retrofit or new,
(4) Type of cutting machine controlled,
(5) Type of numerical control.

(1) There are three modes of movement possible under NC.

(a) Point-to point control,
(b) Straight-cut control,
(c) Continuous path control.

If operations are required only on certain points of the workpiece, for example on drilling machines, jig boring machines or spot welding machines, this is a case for the simplest type of control : point-to-point control. Movement from one point to the next takes place in rapid traverse, wherever possible in two co-ordinates simultaneously.

Straight-cut controls are somewhat more sophisticated. Such controls make rectangular travarses following the directions of linear machine movements. Traverses can take place at normal feed rate or in rapid traverse. Simultaneous movements in two coordinates are only possi-

ble in exceptional cases, and then only at a fixed speed ratio. Straight-cut controls are particularly suitable for turning and milling machines.

Point-to-point and straight-cut control are adequate for machining most workpieces with more complex contours. such as control cams dies, turbine blades, and turned parts with tapers, radii or other curved profiles, require utilisation of the most sophisticated type of control, the continuous path control. Here, machine traverses can be actuated in several coordinates, at various speeds, and simultaneously. Profile milling machines, planning machines, turning machines, flame cutting machines and drawing machines are typical instances where continuous path control may offer advantages.

(2) An important classification of NC machine tools is by the number of axes under tape control. In simple 2-axis systems, only the position of the table is tape controlled in X-Y coordinates. In 4-and 5-axis systems, capability exists for changing the relative orientation of tool and work.

(3) In the early years of NC, *retrofitting* of conventional machine tools with numerical control was not unusual. With retrofitting, selection of the machine tool has proven to be a decisive factor in the success or failure of the undertaking. Examples are widely available.

(4) The types of machine tools on which NC is used can be broken down along conventional lines. A large (about 50 percent) and increasing percentage of all NC machine tools are classed as drilling machines. However, the name is somewhat misleading, because other operations can be performed, such as tapping, boring, and light straightline milling, and even simple two-dimensional contour milling is possible. They are a half way station to the so-called "machining centre," where all, or almost all, operations on a part are done in a single set-up.

Applications of NC to turning, boring, and milling machines will be briefly considered. At least nine different makes of NC lathes are available in the U. S. A. market, ranging from simple point-to point systems (for turning stepped diameters) to contouring systems with three separate tool turrets. NC contour milling machines run the gamut from simple 2-axis machines to the highly complex 5-axis profilers; costs

increase considerably with the number of controlled axes. At least eight makes of boring machines, usually jig borers, are available. High-precision jig-borers, with accuracies of +.00508mm and less, in many cases require an air-conditioned environment.

The NC drilling machine group contains many types and makes. All of these are point-to-point or straight-cut types except the machine centres which may have contouring controls. Machines in this group can be classified in the following manner.

(*a*) *X-Y controlled positioning table* : These tables, of which several makes are available, can be mounted on, or in place of, the tables of standard drill presses. All operations except positioning of the table are performed by the operator.

(*b*) *Single-spindle drills* : This is by far the largest group, and the most popular makes are being produced at the rate of one or more per day in many of the developed industrial countries. The principal reasons for this popularity are the relatively low cost, and versatility in handling the work load of the average metal working plant. Most can be equipped with a milling spindle, and will do light straightline milling besides drilling, boring, and tapping. Usually tool speeds, feeds, and depths are pre-selected manually. The tape controls the cycle until a tool change is required, at which time the operator will also adjust tool speed and feed. Depth settings can be made for a number of tools simultaneously, using cams and quick-change tooling is usually necessary.

(*c*) *Turret drills* : These types have a six, eight or even ten tool turret to eliminate the need for manual tool changes. On some types, speeds, feeds, and depths are pre-selected manually for all tools simultaneously, while on others these settings are completely under tape control.

(*d*) *Toolchanger drills* : A toolchanger drill is equipped with a magazine with positions for 30, 40, or even more tools. Under tape control, the tool on the machine spindle can be replaced automatically by a selected tool from this magazine. The tape also specifies speeds, feeds, and depths for each of the tools. Few are actually operating, but growth appears inevitable because the number of tool positions available on a turret is frequently insufficient, hence, the cycle must be

interrupted to change tools (and also the setting on machines with manual pre-selection). Most experts believe that tool-changers will become standard in the future.

(e) *Machining Centres* : Machining centres are also equipped with automatic tool-changers, but in addition have at least a part indexing capability, or several machining heads, to permit operations on different sides of the work. The name is meant for machines which complete a part, or almost complete it, in a single set-up. This usually requires operations on several faces of the work. The first machining center was introduced in 1958. At least 450 (probably quite a few more) have been sold in the U.S.A. Five-axis machines capable of point-to-point as well as contouring work stand near the top of this scale. The fourth axis on these machines is usually table rotation, as distinguished from the more restricted indexing capability. The fifth axis may be either table tilt or a rotating machining head. The great majority, however, are three-axis machines. Depending on the control system, these machines are capable of contouring as well as point-to-point work or point-to point work only (including, of course, straightline milling). An automatic tool change cycle takes about 10 seconds. These machines are often equipped with pallet shuttles, to enable loading and unloading of parts without loss of machine time.

Conclusion

Numerical Control is one of today's most dynamic manufacturing processes. It is now and will continue to be used in metal-working industries around the world. Higher production rates and reduced waste have been the major claims of most NC users. Numerical Control systems have had a major economic impact for the small job-shop as well as the large factory. It is generally estimated where NC machines have been used that three-fourths of all metal-working production runs are using numerical control systems in the highly developed countries. With the aid of NC, the small job-shop operator is better able to compete with large manufacturers who use long run production procedures. Both small and large manufacturers take advantage of adapting NC systems to various production operations. Essentially, their rationale for applying Numerical Control systems is centered on the conservation of space, materials, time, energy, and most importantly, operators' inaccuracies.

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Capital Intensity in Manufacturing Industries in India : 1960–67

P. K. Ahuja*

Rate of growth of GDP is determined by quantum of resources invested and productivity of such investments. As a corollary, the rate of growth of GDP, given the available investment resources, can be maximised only by investing them where their productivity is the highest. Pattern of production that emerges from growth rate maximisation model may not, however, synchronise with the pattern of demand; in that case, introduction of international trade in the model brings a balance between the two. This is also the basis for Heckscher-Ohlin theorem which prescribes that a country would manufacture (and export) those products which use more intensively its relatively abundant factors. In other words, the over-populated developing countries would maximise growth rates if they adopt labour intensive production strategy and achieve balance between production and demand patterns through the medium of international trade.

Though the above prescription continues to be the central theme in the economic literature for optimum pattern of development, a number of sophistications have been introduced by bringing in other variables like natural resource base, innovation technology, availability of managerial skills and economies of scale [1,2]. Some economists have also pointed out limitations on application of this theory. Abramovitz, Cairncross, Tinbergen and others have demonstrated that technological changes have been as important in raising output as capital investment. Myint[3] advocates setting up of capital intensive industries inspite of their low productivity, as they would lead to larger surplus of output over wage costs, which would make possible a higher rate of investment in the future, ultimately leading to higher growth rate. Bruton[4] links capital intensity with capital deepening, and lack of technical know-how, which result into under utilisation of capacity and over capitalisation. A number of arguments like self-reliance and importance of basic and key

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industries for rapid industrialisation, as also social objectives of development, have also been advanced by a number of Economists.

In this paper, the pattern of development in India during the seven-year period 1960—1967 is studied, covering third Five-Year Plan and the subsequent two years in which there was considerable spill over of the Third Plan Schemes, which represents a land mark for the growth strategy in the hisotry of economic development of India, and have attempted to establish whether the pattern of investment was in favour of labour intensive industries, whether the productivity in labour intensive inudstries was relatively low, and whether there was any corelation between capital intensity, wage levels and profitability.

The analysis suggests that industrialisation in India has been relatively capital intensive inspite of low productivity of such investment. We also suggest that even though productivity of a unit of labour (and capital associated with it) increases directly in proportion to the increase in capital employed per unit of labour, the productivity of a composite unit of labour and capital, declines as capital employed per unit of labour increases. Besides, it is concluded that the wage levels are closely related to the extent of mechanisation among industries and that the highly mechanised industries have shown low levels of profitability.

Some Assumptions

Capital intensity is considred as a flow coefficient and mechanisation as a stock coefficient. The value added by manufacture has been divided into three parts: (i) payment to labour, which includes wages, salaries, bonus, regular or otherwise, overtime payment and also the value of payment in kind; (ii) payment to capital, which includes depreciation, representing value of fixed assets consumed during the process of manufacture and reasonable rent on capital employed[5];10 percent rent on

5. Capital employed has been defined to include net fixed assets and working capital; the latter has been taken to include value of inventory stock of raw materials, in process material, as well as finished products; debtor and creditor balances have not been taken into account, as they represent book adjustments; from national angle only physical stocks constitute working capital; this definition of capital employed conforms to "invested capital" as classified in the Annual Survey of Industries as distinct from "productive capital" which includes cash and credit balances as well. Capital employed in a year should normally be average of the flow of capital employed during the course of a year, as, however, such data are not available, the year end invested capital has been taken into account. Due to a secular trend of increase in capital employed by the industry, the year end data would lead to over estimation. The error, however, would be small and would not effect the results.

capital employed has been considered adequate taking into account the interest rate structure in 1967; (iii) whatever remains from the value added by manufacture after paying the labour and the capital has been taken as payment to enterpreneur and represents payment for risk taking and for organising the factory production. Capital intensity (C_1) has been defined as ratio of payment to capital and enterpreneur (ii+iii) and the value added (i+ii+iii).

The value added by manufacture has been arrived at by deducting value of material inputs and utilities from ex-factory value of production. Ex-factory value of the production depends on a number of extranuous factors. Price controls would tend to reduce the sales realisation whereas market scarcities would tend to push it up leading to much higher payment to the enterpreneur. Similarly, accounting value of inputs can be low depending on import quotas and allocations. Prices will also depend upon monopolistic conditions in an industry and imperfection of the market. Thus the ex-factory value, or payment to enterpreneur, is subject to a number of non-functional variables which might more appropriately be omitted while considering capital and labour intensity of a products[6]. With this end in view we have made alternative analysis by taking the value added, net of profits of enterpreneur, assuming that the 10 percent rent on capital employed would also include payment for risk taking and would eliminate the need for separate return to enterpreneur. Capital intensity (C_2) has accordingly been worked out as ratio of payment to capital (ii) and value added excluding enterpreneur's profit (i+ii).

Mechanisation (X_1) which is a stock co-efficient has been measured as value of net fixed assets per employee in an industry. Stocks constantly locked up in a manufacturing industry are in many respects, particularly for the purpose of investment planning, similar to the fixed assets of the industry. Alternative co-efficient of mechanisation (X_2) has, therefore, been worked out representing value of capital employed by an industry per employee.

Industrial date for 1967 published in the Anual Survey of industries have

6. Chenery, H. in "Comparative Advantage and Development Policy" *American Economic Review*, Vol. 51, explain that accounting value added cannot give functional as it includes monopoly profits, rent from import control, factor price ratio variation tariff and quota protection and due to lack of reallocative ability.

been used for a cross section study. Two digit classification of Industries which gives 20 industrial classes has been adopted.

Analysis of Data: Observations

Analysis of the data shows that the value of net fixed assets per employee (X_1) varies widely from industry to industry, the range being from Rs. 1,062 for tobacco industries to Rs. 1. 15 lakhs for petroleum and coal industries. If the industries are arranged in ascending order according to the net fixed assets per employee (X_1), the highy mechanised five industries falling in the last quartile accounted for over half of the total net fixed assets in the manufacturing sector at the end of 1967, but for only 30% of the value added by manufacture in the year. Average productivity of capital, defined in terms of value added during the year as percentage of net fixed assets, in these industries was only 31 percent as compared with 165 percent for the first quartile industries, and 85 percent for the second quartile industries as would be seen from the following table.

Mechanisation, Fixed Assets and Productivity of Capital

Quartile Group	*Range of Mechanisation (X1) (Thousand Rs. per employee)*	*Value of net fixed assets in the industries. (Rs. crores)*	*Value added by the industries (Rs. crores)*	*Value added (Rs.) per Re. of net fixed assets.*
I	1.1-3.8	65	107	1.65
II	4.3-7.6	1110	939	0.85
III	7.8-13.2	691	387	0.56
IV	21.2-114.6	2070	635	0.31
	Total :	3936	2068	0.53

Pattern of Investment as revealed by increase in the net fixed assets in the 20 industrial groups between 1960 and 1967 has been analysed with a view to establishing if there has been any bias in favour of the labour intensive industries. Linear regression function has been fitted to the

degree of mechanisation (X_1 in terms of value of net fixed assets in thousand rupees per employee in 1967) and percent growth in value of net fixed assets (G) during 1960-1967 among the 20 industrial groups. The following equation has been obtained.

$$G = 217 = 2.680X_1 \ (= f + 0.3499)$$

Correlation between the extent of mechanisation and proporationate growth rate of fixed assets during 1960-1967 is positive but not quite significant. From this it is suggested that the highly mechanised as well as less mechanised industries have grown independently of the consideration of alternative uses and productivity of investment resources, and that labour intensive industries did not receive any preference in investment decisions during 1960-1967.

The lack of emphasis on labour intensive industries is brought out more forcefully if we compute regression of capital intensity (C) in 1967 on growth of fixed assets during 1960-1967 (G), both coefficients expressed in terms of percentages. The following regression equations have been obtained.

$$G = 32.8 + 5.218\ C_1 \ (f_1 = +0.5313)$$

$$G = -19.3 + 5.957\ C_2 \ (f_2 = +0.4320)$$

Correlation ratios r_1 and r_2 are significant at 99 precent and 95 precent levels respectively and the results suggest close positive correlation between capital intensity and growth of fixed assets. In other words, relative growth in capital investement has been faster in capital intensive industries than in labour intensive industries, and consequently, the share of labour intensive industries in total capital investment has declined during 1960-1967. The capital intensity is, however, based on full payment to the capital employed irrespective of the extent of its utilisation. It is matter of fact that fixed assets have remained underutilised. Our above results, however, would remain unchanged, as low capacity utilisation does not prevail only in capital intensive industries.

The implications of capital intensive oriented industrial development can also by demonstrated by analysing elasticity of productivity labour with reference to the extent of mechanisation. Analysis of ASI data for 1967

suggests that productivity of labour is closely determined by degree of mechanisation. Linear regression functions fitter to value added per employee (Y) and mechanisation (X) give the following results :

Function	a	b	r
$Y = f(X_1)$	4.05	+0.1852	+0.9328
$Y = f(X_2)$	3.03	+0.1673	+0.9430

Correlation (r) is highly significant. This is also obvious from the basic data. The lowest labour productivity of Rs. 2762 is in footwear and made up textile industries, in which net fixed assets per labour are also the lowest at Rs. 1,532. On the other hand petroleum industry in which the labour productivity is the highest e. g. Rs. 25,332, the net fixed assets per labour are also the highest at Rs. 114,607. We, however, conclude from the above linear regression functions that if an industry is more mechanised than another by Rs. 100 per employee, value added by it per employee per year is higher by Rs. 17-19. But, we have seen from earlier analysis that the average value added per Rs. 100 worth net fixed assets in all manufacturing industries is Rs. 53; in the highly labour intensive quartile industries it is as high as Rs. 165. This shows how steeply the productivity of capital declines as production pattern shifts to more mechanised industries. In other words, the marginal capital output ratio with reference to increase in degree of mechanisation as between industries is as high as 6:1 as compared to the average capital output ratio of 2:1 in all the manufacturing industries, and only 0.6:1 in the labour intensive first quartile industries. Immediate labour absorption and value added by manufacturing industries can thus be significantly raised if emphasis is given on labour intensive industries and techniques.

But the conclusion that productivity of labour is higher in more mechanised industries is distorted and can be contested. The productivity of labour taken in the above analysis (Y) refers to value added jointly by a unit of labour and capital associated with it. The conclusions get reversed if capital is also expressed in terms of labour. We have followed the usual methodology to estimate productivity of a composite unit of labour and capital expressed in terms of labour. Net fixed assets in the various industries have been converted into labour on the basis of

average wage rate of Rs. 3,269 in the machinery industry (in 1967). To this, total number of employees engaged in each industry is added. This gives gross employment in each industry; value added by each such employee gives net productivity of a composite unit of labour and capital in that industry (T, expressed in thousand rupees). This co-efficient shows variation from Rs. 650 per labour unit in basic metal industry, which is highly capital intensive, to Rs. 3,380 per labour unit in tobacco industry, which is a labour intensive industry. Linear regression of T on X_1 gives the following results :

$$T = 1.92 - 0.01437\ X_1 \quad (r = -0.5298)$$

The correlation is highly significant and suggests that the productivity of a composite unit of labour and fixed assets declines as we move to more mechanised industries. If net fixed assets per employee in an industry are higher by Rs. 100 than in another industry, its productivity is reduced by Rs. 1.44 per composite unit, representing labour and fixed assets.

We have next fitted linear functions on data for wage rates (W), mechanisation (X_1) and profitability (P), the latter defined as payment to entrepreneur, excluding payment of 10 percent or on capital employed, as percent of capital employed. The results suggest that wage rates are relatively high in capital intensive industries, that high wage rates are associated with low profitability and consequently profitability declines as the extent of mechanisation increases as between industries. The results are shown below.

Function	a	b	r
$W = f(X_1)$	2.4	+0.024	+0.685
$W = f(P)$	3.0	−0.036	−0.442
$P = f(X_1)$	7.84	−0.112	−0.255

Correlations between wage rates and mechanisation are highly significant. The capital intensive industries pay high wages, as the incidence of such high wages on exfactory cost of production is low and also presumably because they employ technically qualified workers who can handle sophisticated and costly equipment with more confidence. The high wage rates, however, seem to depress profitability, in the industry

as is evident by negative correlation between the two which is significant at 95 percent level. High wage rates associated with low profitability and high capital intensity suggest that capital intensive industries are faced with low profitability. The regression co-efficient shows that as net fixed assets per worker increase by Rs. 100, profitability is reduced by 0.011 percent of the capital employed. It is not necessarily correct that high wage rates paid in capital intensive industries are responsible for low profitability in those industries. A number of factors could be responsible for low profitability. Capital intensive industries in India are generally established to create dynamism in the economy; their price policies are accordingly not always governed by profit considerations but are broadbased to induce rapid industrialisation through forward and backward linkages. This is specially true in respect of public sector units.

Conclusions

The above analysis shows that during 1960-1967 we invested more in capital intensive industries, implying inefficient use of resources as well as profitability, as productivity in these industries was relatively low and wage level high. Transfer of investment funds from capital intensive to labour intensive industries at planning stage could have raised the rate of growth of value added by manufacture, and national product. This remark is, however subject to two important reservations which have been emphasised at various forums. Firstly, it assumes that exportable surplus of labour intensive industrial production could be exchanged with capital intensive products through the medium of international trade. In practice, the international trade does not face perfect market situation. Developing countries can hardly find foreign markets for their labour intensive products. Terms of trade for their labour intensive products are also constantly on decline leading to reduction in real gain from specialisation in production of labour intensive products.[7]

Moreover, an open economy might face wider economic fluctuations as compared to a closed economy as the recent international developments

7. Ahuja P. K., "Terms of International Trade and Development of the Developing Countries" U. N. Asian Institute for Economic Development and Planning. Occasional Papers, Vol. 3, May 1970. It has been demonstrated that there is a long-term tendency for terms of trade of developing countries to deteriorate and this tendency being due to economic structure of the countries, will have to be accepted as an unavoidable factor while planning for economic development.

have revealed, which a less developed developing country can ill afford. Secondly, growth of an industry has to be considered as a part of well-knit programme. An industry, though capital intensive, may be a growth point, and may have backward and forward linkages, which may be labour intensive, or may be natural resource based. Qualitative and non-economic benefits might also be strongly in favour of high growth rate of capital intensive industries.

As regards the first reservation, it seems that the planners in the past have been giving high emphasis on capital intensive industries on the assumption that due to various constraints, domestic as well as external, India has to be a relatively closed economy, being not in the best situation to take maximum advantage of international trade, and could not integrate its pattern of investment with the pattern of international specialisation. This fear was born from poor performance of our exports, inspite of high level attention given to export policy and performance.[8] During the seven years 1960-61 to 1967-68 (comparable to the years for which ASI data have been analysed), quantum of our exports increased by merely 22 percent, or only 2 percent annual compounded, whereas the world export quantum increased by 55 percent during the same period. If we were to raise our growth rate significantly by integrating a sizeable part of our economic development with world market demand, our exports should have been expected to increase faster than even the rate of increase of world exports, so as to provide funds for growing imports needed to meet domestic demand arising from imbalanced but growth oriented production programme. Poor export performance has been the subject matter of research at various levels.

Based on this research, two basic impediments might be identified. Firstly, our domestic inflation has been far in excess of the inflation in developed countries, which alone can provide substantial outlets for our exports.[9] This phenomenon has kept the prices of our exports relatively out of line and have kept exportable surpluses at rather low levels.

8. Exports have increased considerably during the last two years, the rates of growth in 1974-75 and 1975-76 being 32 percent and 16 percent respectively. But even in 1975-76 our exports would constitute only 6 percent of our GDP as compared with 8 percent in 1960-61 and 7 percent in 1965-66.

9. The trends have been reversed during the past few years, specially after declaration of emergency. Price level in India is now more stable than in other consuming or competing countries. This also explains why our exports have increased substantially during these years.

Secondly, bulk of our investment has been on sheltered import substitution, which has resulted in our products being non-competitive in terms of quality, price and delivery terms. If we set up certain industries by creating high quota and tariff walls and expect those very industries to participate in our export trade in a dynamic way, without first giving them a chance to prove their ability by dismantalling, or reducing the barriers around them, we can hardly expect our exports to increase at a pace so as to enable the economy to gain substantially from international division of labour. Allocation of resources in favour of capital intensive industries, in which their productivity is low, pushes up the cost structure, thereby making our exports less competitive.

As a result of these policies we have invested relatively large resources into capital intensive import substituting industries. During the seven years 1960-67 productive capital in the manufacturing factories Increased by Rs. 4042 crores, of which Rs. 2439 crores, or 60.3 percent was invested in the five last quartile capittal intensive industries. Marginal productivity of investment in these industries measured in terms of increase in value added (at current prices) as percent of increase in productive capital (during 1960-1967), was only 13 percent as compared with the marginal productivity of 35 percent for the remaining 15 industries of the ASI classification. These ratios will change if productivity at constant prices is estimated, but this would not significantly alter the relative marginal productivities of investment in five capital intensive industries and the remaining 15 industries, which are in the ratio of 1:2.7. It is not only the productivity of capital which is low in capital intensive industries, but combined productivity of labour and capital (latter converted into labour) also declines as capital intensity increases, even though the value added by such industries is based on high average wage rates paid by them.

Pattern of investment followed during 1960-1967 has been repeated in the Fourth Plan, and also in the Fifth Plan. The main force behind heavy investments in capital intensive import substituting industries seems to be the need for achieving self reliance in view of static export earnings and in adequate foreign exchange resources. Our imports in 1960-61 aggregated to Rs. 1800 crores (Post-devaluation Rupee); after 12 years, in 1972-73 the imports were exactly at the same level. In the meanwhile, value of our GDP, at current prices, increased three fold from Rs. 14,007 crores to Rs. 41,108 crores. Average import co-efficient thus went down

from 12.8 percent in 1960-61 to only 4.4 percent in 1972-73 and marginal co-efficient was zero. Investment pattern has accordingly attempted to create capecity for whatever we needed, irrespective of the social cost of production, assuming that it would be against the social interest to depend on the medium of international trade in order to exchange domestic goods, which can be produced with the least cost, with foreign goods, which would require greater costs, if produced within the country.

The second factor concerning qualitative and non-economic benefits as also linkage effects in well knit plan, has also been an important motivation for investments in capital intensive industries. Among the 20 ASI industrial groups, the five highly capital intensive groups are petroleum, basic metals, metal products, chemicals and machinery industries. Basic metal industry is based on indigenous iron ore, manganese ore and bauxite, and has been established due to locational and natural resource base advantages. Development of petroleum industry, petro-chemical complexes and chemical industries is basic for dynamic industrialisation, as these industries provide raw material and intermediate products for a large variety of industries. The machinery manufacturing industry has also its own strategic importance of providing basis for other industries, and for creating reinvestment quotient. All these industries though capital intensive, are important for repid and sustained industrial development of the country, and for providing multi-linkage effects, ultimately leading to large and substantial labour absorption potential, even though they themselves provide limited employment directly.

Policy planners have also emphasised development of these Industries from point of view of self-reliance, prestige and their importance for rapid industrialisation. In approach towards industrialisation, the Fourth Five Year Plan advocated that requirement of capital equipment, metals, petroleum products and chemicals are growing fast and in order to reduce dependence on imports of theses items and for progressive self reliance, heavy investment in domestic production of these capital intensive industries would be necessary. Even in the preface, the Fourth plan document states. "We should rely more and more on our own machinery and technical know how even though it may entail some initial risks and difficulties. It would be folly to forget that a nation's strength ultimately consists in what it can do on its own and not on what it can borrow from others." Fifth plan is also based on inter-industry input-output matrix and elaborate system of material balances. Industrial development

strategy has been formulated "keeping in view the twin objectives of self reliance and growth with social justice." Maximisation of output from given resources for investment dsoe not seem to have directly entered the detailed calculations, though the Development Plans emphasise that industrialisation would provide large employment opportunities. Importance of heavy and capital intensive industries in over all industrial and economic development can hardly be underestimated, specially in view of limited role that international trade can play in bringing balance between optimum patterns of trade and production, but at the same time the effect of such inevitable investment pattern cannot but depress the rate of growth of national product as compared to the rate that would be possible otherwise. □

Funds Planning Through Network

Ram Prakash*

Implementation of Five Year Plans in the past, witnessed both excess and inadequate availability of funds for individual projects. Some projects were not able to fully utilise the funds during the period for which allotted, while many others could not make sufficient headway due to inadequacy of finances. Efforts had been made to evolve a system through application of modern techniques as could ensure rational allocation of funds among projects. Successive plan documents have emphasised the application of techniques like PERT, CPM, Performance Budgeting for better planning and implementation of projects. Bureau of Publice Enterprises made the use of Network obligatory for all the pubiic sector projects. Tnis had a positive impact, but general feeling was that more could be done in allocating plan funds, on need base basis.

In U. S. A. some of the multi-projects undertakings use network for funds planning among their units. Extension of same principles to the problem of funds allocation among different projects at macro planning level is emphasised in various training and oreintation/programmes on PERT/CPM. These are enumerated as a part of Resource Based Network. Accordingly, it is often suggested that if investment proposals from project authorities for inclusion in Annual and Five Year Plans were asked on the basis of Resource Based Network a number of problems of funds imbalance would be resolved.

Objective

A major assumption in asking resource based network is that it would help in rational allocation of plan finances among the projects and that would pave the way for optimum use of funds whose paucity is well known. In this paper, it is proposed to explain the concept and operational aspects of the resource based network and examine the extent to which the underlying assumption is vaild.

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Fig. 1

available latitude for actual accomplishment of any event without jeopardising the project end date is known as the slack time of an event. Such a latitude is not available for the events on critical path as would be seen for Event 'C' and for that reason these are scheduled *de facto*, The available slack on non-critical events indicates a range of time over which these could occur without affecting the project duration. Such a range of time in a complex project is quite enormous.

ACTIVITY FLOAT : Similar to event slack there is 'Float' time to an activity. It is the amount of leeway available over and above the actual activity duration. In simple words, it is the difference between the time available for the performance of the activity and the actual activity time. The available time to an activity would depend on the earliest and latest dates of the preceeding and succeeding events. It is, in fact the principle of network construction that an event can only be achieved when all activities on route to it are completed. The dates at which an

Anatomy of Resource Based Network

Concept : A resource based network integrates the time schedule with the availability pattern of essential inputs of the project namely man, material, and money. The starting point for application of resource based network is the project network prepared after using PERT/CPM, techniques. PERT/CPM gives a general time frame on which scheduling of operation is carried out. Scheduling is disposition of all activities on a calendar scale. The initial general time estimates on the project network are set on the presumption that

activity can be started and finished are conditioned by the earliest and latest dates of events which immediately precede and succeed the activity. Thus if any network event has a time range (between event earliest date and event latest date) over which it can be achieved it follows that activities closely associated with that event will have similar ranges of dates over which they can be carried out without affecting end date of the network. These activity range dates constitute two activity cycles—Earliest Cycle (the earliest an activity can be carried out) and a Latest Cycle (the latest it can be accomplished). The two cycles are identified by the four dates namely:

Earliest Cycle	Earliest start date (T_{ES}); Earliest finish date (T_{EF})
Latest Cycle	Latest start date (T_{LS}); Latest finish date (T_{LF})

The above two cycles can be illustrated on activities BE and DE of Fig. 2 as under :

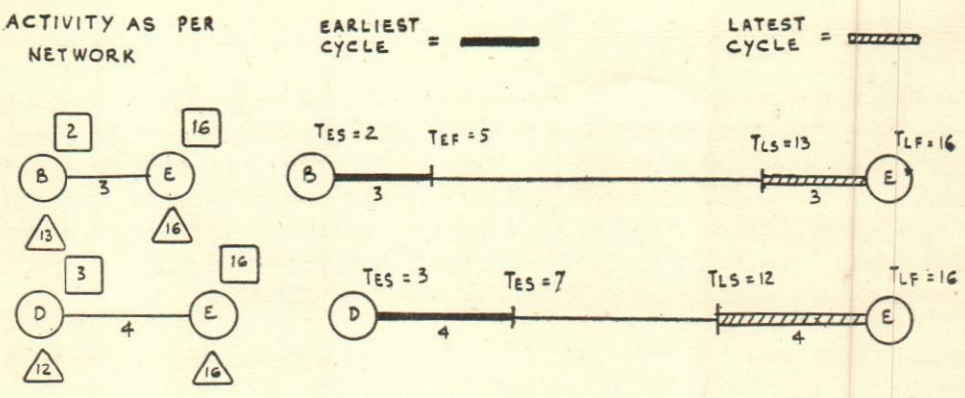

Fig. 2

Time Plan Alternatives : The earliest and latest cycles of activity performance indicate two extreme alternatives in which a project can be implemented without changing the end date. Arranged on a time scale,

the two alternatives for the above simple network in Fig. 3 are shown below:

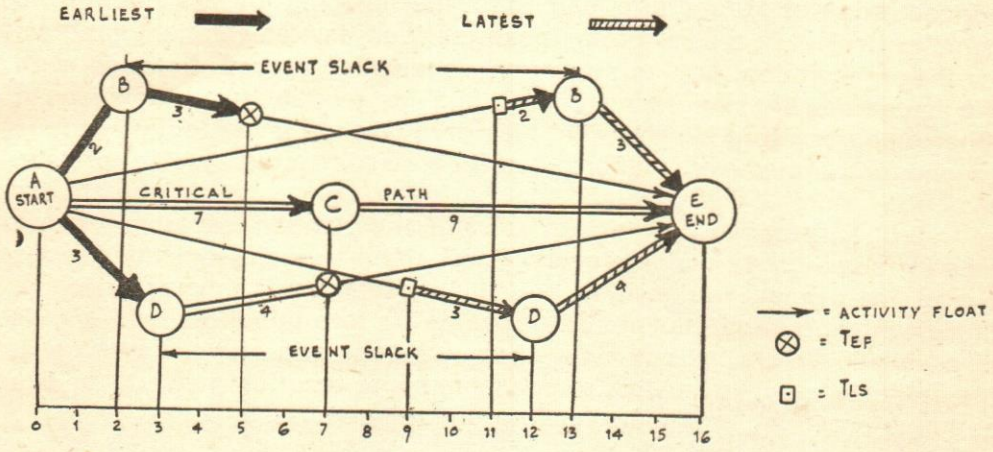

Fig. 3

If it is decided to carry out the activities on the basis of latest cycle then requirements of resources for their accomplishment will also shift correspondingly. In between the two extremes of earliest and latest cycles of activity performance, there can be innumerable choices on the scheduling latitude without altering the project end date.

Funds as a Criterion for Scheduling

Upper and Lower Limits of Fund Requirement : The requirement of fund on the basis of earliest scheduling cycle in a specific period will indicate its upper limit while the one worked out on the basis of latest cycle will show the minimum needed because there would be no further scope of postponement. A decision to implement the project on the basis of latest cycle would postpone funds utilisation to subsequent period rather than altogether eliminate its need.

Problems Envisaged : If money availability is the sole consideration for deciding the scheduling dates on the leeway, two complications arise. Firstly, there is a likelihood of the problem of imbalance between quantum

of available funds and organisation capacity to spend it effectively over the specified period. The postponement of funds allocation to the period that follows means lumping of activities on some future date. The concentration of expenditure leading to the lumping of activities in a complex project in a period may pose serious implementation problem for the organisation. An organisation is usually geared to cope with the limited activity performance level and its capability in relation to other resources vary slowly. This type of imbalance leads to infructuous expenditure and adversely affects performance standards in the project. Secondly, there is the problem that in deciding to carry out all the activities in the network as late as possible the planner leaves no spare time for some future contingencies. In that case when something goes wrong the project authorities are to undertake crash programme of implementation at additional cost for adhering to original schedule date of completion. On the contrary, when every operation is carried out at the earliest time it is feasible to conserve spare time for possible delays and thus providing safeguard for future contingencies.

Possible Way Out : In circumstances when paucity of funds is well known there is a natural tendency on the part of planners to postpone funds allocation as late as possible and on the part of project authorities to pitch their demand for money as high as they can. A project network can give support to both. This problem can be sorted out scientifically if scheduling of project is decided with regard to all the resources viz. men, machines, materials and money ensuring their optimum and uniform utilisation. The scheduling of activities on the basis of funds should be done last and for that purpose, only that part of the slack which remains after ensuring optimum and uniform use of men and other facilities, should be used. The main reason of finance being suggested as the last scheduling criterion is that within the project sanctioned cost money is relatively more flexible a resource. A public investment proposal passes through various hands before it is sanctioned and attempt is made to determine its most economical cost. Once a project is sanctioned necessary plan funds have to be provided for its timely implementation. Within the fixed ceiling only limited resources (men and equipment) can be made available and this fixed quantity has to be shared between several activities. Under these circumstances most effective implementation policy on the part of project authorities is to keep all equipments and labour fully and continuously occupied as far as possible. The general method of arranging work schedule so that there

is always a uniform level of resource utilisation is described in subsequent paragraphs.

Resource Based Scheduling Procedure

Grouping of Non-Critical Activities : The activity times are the foundations from which resource optimisation is built. On a project network these are always several non-critical activities with positive slack values. These may be first of all grouped together according to same or similar resource requirements But in real life a large number of resource items are needed for project completion. If resource variables are not limited to manageable proportions it will frustrate the achievement of optimisation and levelling of resources. So while grouping the activities the resource variables are to be carefully chosen and limited to key ones only. After so grouping the activities these should be segregated from the project network and redrawn separately. Their activity duration, earliest expected and latest allowable times as per the network may be indicated; and selected resource requirements may be worked out.

Time-Cost Trade off : While determining needed resource it is important to examine its cost relationship with activity duration so that most favourable optimum balance of time-cost trade off is assessed. The resource availability can seldom be stated without qualifications. Even in case of technical skill which varies at a relatively slow rate in the short period, it is possible to augment it at increased cost by over time and week end working. The time-cost trade off analysis will help in working out resource requirement with due regard to associated cost for permissibie increase of work capacity and will indicate optimum requirement under given constraints.

Iterative Process : Resource optimisation and levelling is then done through iterative process by taking one variable at a time and re-examining the first after the second one is optimised. If, however, availability of resources is less than the optimised requirements a backward working will be necessary to change activity timings and reach a position when revised optimum requirements match the availability. This iterative process can be performed either manually or through a computer programme depending on the size of the project and variables in question. Even with sophisticated mathematical techniques some

measures of 'trial and error' procedures cannot be avoided. After levelling and optimisation of all the major scarce resources the start and finish dates for each activity would be finalised.

The above process is illustrated below through simple example of resource loading for a specific category of manpower and material to ensure their uniform and optimum level of utilisation.

Manpower Loading

Example Description : Suppose in a project network there are four independent activities which require inter-changeable men engineering skills. The information relevant for manpower levelling and optimisation is as under :

Activity	*Men required*	*Activity Duration*	*Earliest Cycle*		*Latest Cycle*		*Slack*
			*Start**	*Finish*	*Start**	*Finish*	
W	5	2	0	2	5	7	5
X	5	3	2	5	7	10	5
Y	2	3	0	3	6	9	6
Z	3	4	3	7	6	10	3

*Refers to end of the time period.

Men Requirement Before Levelling : The men requirement for each time unit from project start is assessed from the above information and is indicated as under :

Activity	*Time from Project Start for Earliest Cycle*										*Time from Project Start for Latest Cycle*									
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
W	5	5	—	—	—	—	—	—	—	—	—	—	—	—	—	5	5	—	—	—
X	—	—	5	5	5	—	—	—	—	—	—	—	—	—	—	—	—	5	5	5
Y	2	2	2	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2	2	—
Z	—	—	—	3	3	3	3	—	—	—	—	—	—	—	—	—	3	3	3	3
Total	7	7	7	8	8	3	3	—	—	—	—	—	—	—	—	5	10	10	10	8

The performance of above activities requires 3 to 8 men on the basis of earliest cycle and of 5 to 10 if these are scheduled as per latest cycle.

Need for Levelling : Ideally, it is most advantageous to bring down the maximum men requirements as near the average as possible without becoming less than the optimum men required on any activity so as to avoid high fluctuations in their requirement. Limiting the manpower resource at a constant level will ensure continuous flow of work and would avoid waste of manpower arising from under employed.

Human Resource Levelling : The average manpower required can be worked out by dividing the total man days (men X activity duration) by a modal latest allowable activity time. The total man days in the above example is 43 (5x2+5x3+2x3+3x5) and the nodal latest allowable activity time is 10. The average men required is 43 divided by 10 i.e. 4, but optimum men required for activities W and X are 5. So the manpower loading has to be levelled in the neighbourhood of 5 men through scheduling. The feasibility of scheduling by loading 5 men on project working days can be easily assessed through a bar diagram drawn to time scale as shown below :

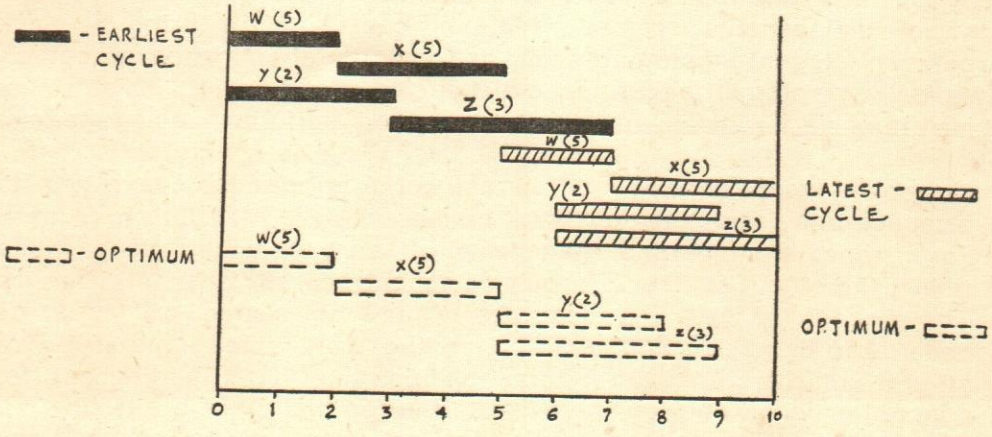

Fig. 4

It will be seen from the above bar diagram that by scheduling Y and Z activities in such a way that these are started in the 6th period and

are completed at the ends of 8th and 9th period, it is possible to restrict the manpower requirement to a uniform level of 5 except in the tenth period when there is need for 3 men only. In doing so, available slack of 6 and 3 on Y and Z activities has been reduced to 1 each and slack of 5 on each of W and X activities has not been used. The now available slack time of 5, 5, 1 and 1 respectively on events of W, X, Y and Z can be used for deciding the scheduling on the basis of other resources like equipment, transport, scarce materials.

Material Loading

Similar Approach : The procedure to integrate availablity pattern of resources like transport, power, equipments and other inputs with the time plan is similar to the above. The main object is to make available the materials just when these are required so that there is neither excessive prestocking nor shortage. The periodic requirements of various inputs in different periods are assessed from the activities as scheduled for performance after manpower optimisation. In case it is not possible to ensure their timely required supply after taking into account the delivery lead period of inputs, some adjustment inscheduling of activities might be made. The modifications will call for evaluation of potential benefits against additional costs. While using the slack between latest available and scheduled timings after manpower optimisation some margin for future contingencies might be left. The safety margin of slack will depend on the past delivery performance of materials.

Composite Input Variables : In certain works, it may be convenient to establish one composite constraint instead of separately applying them. For instance in concerting, the volume of work on each activity would reflect the output of labour, equipments and certain critical materials. The process of levelling (as was done for manpower) could be undertaken by making the total concerting work spread uniformly for all the activities. After uniform loading the total reqirement for concreting could be compared with the constraints of availability. If the two do not balance scheduling of activities may be changed and redisposition of activities on a calendar scale may be shown. The establishment of start and finish dates for each activity after optimisation and levelling of all men and other facilities would pave the was for funds loading.

Funds Loading

Funds Milestone Bar Chart : The assessment of funds for all the activities may be done with the help of milestone bar chart. Each activity duration from start to completion as scheduled may be shown with a bar cut to the time scale. The likely dates of payments depending on the terms say for order, part supply, work progress, supply completion, erection completion, plant commissioning, final payments may be shown on the bar as milestones symbolically with inverted triangles and below it the amount to be paid may be indicated To get the best out of Funds Milestone Bar Chart, it is necessary to indicate individual activity and tendency to show a complete section of the network on the ground of avoiding complexity may be avoided. A section of network usually comprises a number of activities which require different patterns of investment. The quarterly and annual totals of all such payments will give the requirements of funds. While working out of the funds requirement adjustments for advanced and delayed or spill over payments may be made A simple example of Milestone Bar Chart for funds requirement is given below :

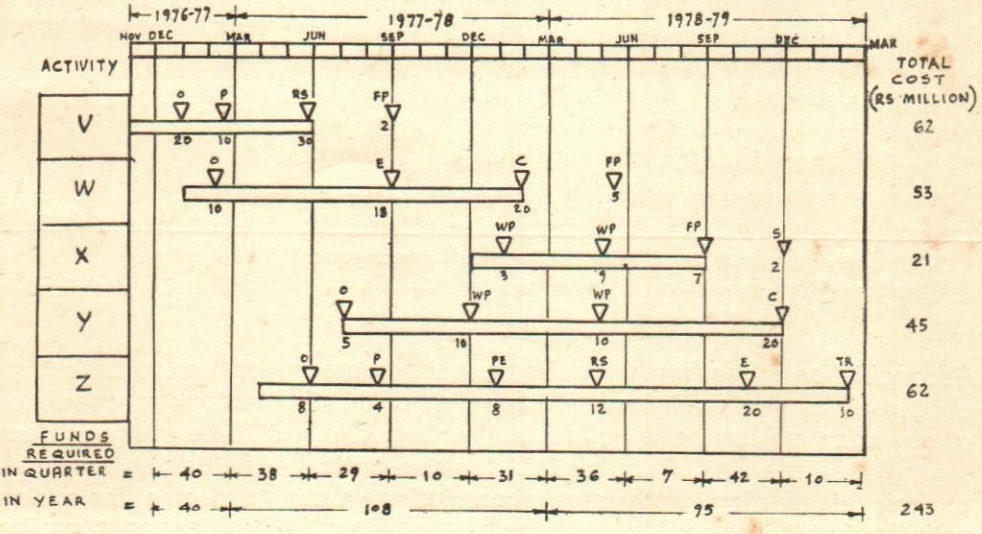

Fig. 5

Funds Statement : The next step is to prepare a supporting statement of funds requirements linked with the network. The statement summarises physical progress, terms of payment and details of payments contained in Milestone Bar Chart. In addition to all the project activities this statement will include administrative expenses and provision for contingencies (imprest money) so that total periodic funds requirements are known. The tabular details supplement the diagram rather than replace it. The following illustrative format of funds statement is found useful for the purpose:

Activity	*Qty. of work anticipated*	*Total value involved*	*Terms of Payment*	*1976-77**			
				Work to be done	*Payment Due*	*Adjustments† plus or minus*	*Total to be paid*
1	2	3	4	5	6	7	8

*Columns similar to 5, 6, 7, 8 would be repeated for subsequent years.
†Plus for spill over and minus for advance payments.

Reconciliation : The funds requirement thus determined has to be reconciled with its availability. If the two do not match a further rescheduling of activities may be done without affecting the end date of the project. In any case the funds requirement for non-critical activities on the basis of their latest start and latest completion dates and also for critical activities must be provided, otherwise there would be danger to project completion dates. When a very high degree of perfection of 'best' possible schedule after examining all possible combination is reached, there is likely to be very little difference between the funds demanded by project authorities and those allotted by Planners.

Conclusion

The methodology of funds planning through a resource based network helps in scientific assessment of the funds requirement by Planners for public sector undertakings provided two conditions are fulfilled. Firstly, before undertaking funds planning a fully optimised schedule of activity performance is built. Such a schedule of performance is founded on activity times indicated in the network and lies between activities performance range of earliest and latest cycles. For that purpose various activities of project network are ministered to a calendar scale through heuristic process in which the analysis of planning network elucidates the problem and the subsequent reanalysis evaluates proposed solutions (i) to ensure optimum and uniform utilisation of men, machines and material and (ii) to integrate their requirements with availability. Such a schedule of activity performance would narrow the available slack and as such there will be little difference between the funds required on the basis of earliest and latest cycles. Second prerequisite condition to be satisfied is that all necessary details are meticulously worked out and each money involving activity rather than a section of network is depicted on the Funds Milestone Bar Chart. A network section involves a number of activities having different pattern of investment and that would not correctly show funds requirement.

The advocacy of the technique is also subject to one precaution. Even with the most sophisticated mathematical programming in funds planning some measure of 'trial and error' procedure and application of managerial experience cannot be avoided. This technique has to be, therefore, fully absorbed and used with discernment so that it serves the management as a servant rather than becomes their master. □

Workers' Participation in Management

Mahesh Chandra*

Never before in India, the significance of the term 'Prosperity through Productivity' was realised in its right perspective than today. It is widely accepted that it is through accelerated production and productivity in all branches of economic activity that a faster rate of economic growth can be ensured. Thus, in real sense, higher production and productivity become the corner stone of socio-economic planning. The higher rate of production and productivity enjoins upon both labour and management to contribute their best in their respective spheres. Whereas the labour must develop a sense of realisation that their well-being is largely dependent upon the prosperity of the enterprise, the management must ensure at the same time that no injustice is done to the cause labour. Management in its own interest, should inspire confidence in the mind of the worker that he is a partner in the process of production. If a worker's status as a free individual is recognised and suitable place in the industry provided, the entire situation is bound to undergo a radical change for the good of the industry and that of the community, as a whole. A fruitful amalgam of these two factors of production is, therefore, a must. The Indian worker today is fully conscious about the position, he has come to occupy and the vital role he is expected to play in the developing economy of the country and has thus become a potent factor to be reckoned with. The industry can, therefore, no longer afford to ignore the rightful place of the worker in the management. Indeed, this approach will open new dimensions and new vistas in the field of industrial relations to meet the growing challenges of the time.

Workers' participation in management has been rightly described as a strategy for achieving the goal of the growth and development of the economy and industrial enterprises. It is not merely an instrument for creating a necessary conducive climate, wherein industriai disputes become redundant but it also helps in the promotion of *constructive co-operation* and *better understanding* between the labour and the management. The worker's emotional involvement in the affairs of the management is an essential ingredient of industrial democracy. It provides workers an increasing degree of influence in organisational

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decision making process from shop level upwards to the plant level. The increasing degree of influence means participation by workers in the important affairs of the management on the basis of *equity*. Such a participation will make worker's representatives a party in taking decisions along with management on certain matters concerning them such as conditions of employment, production programmes, welfare and security measures, profits, markets, international competition and the distribution of the income generated, etc. The need for such an institution was felt not only from the stand point of social justice but also for achieving a higher level of organisational efficiency. The ultimate objective of the system is to train the workers in administering the affairs of the undertaking and to pave the way for the introduction of a labour-oriented managerial system.

Background

A demand for workers' participation in management first grew in the western industrial societies, particularly, in the wake of Industrial Revolution. In fact, this concept was strongly advocated by the Marxists, who envisaged more or less complete control of industry by state, as a workers' representative. However, this concept was later revised and more moderate human considerations emerged. With the passage of time the labour and capital were increasingly regarded as inter-dependant or interrelated groups in the production processes, rather than opponents of each other. With the emergence of democratic forces and socialistic planning, the concept of workers' participation in management gained momentum. The concept covers a variety of approaches in different countries, for instance, setting up of works councils in the United Kingdom and Singapore; works committees in France, Pakistan, Finland, Belgium and Tanzania; enterprise trade union committees in the USSR, Hungary and the German Democratic Republic; workers' self management in Yugoslavia, etc. The enterprise collective bargaining gained popularity in the United States, Nigeria, Malaysia and Argentina. The workers' participation in management presents itself very differently in some of the highly advanced countries as compared to some of the developing countries. In most of these countries the system of workers' participation was introduced and developed through evolutionary and legislative process. To-day, many of them have attained higher forms of participation.

Indian Experience

So far as India is concerned, numerous measures on systematic lines have been taken especially after the country attained independence, to experiment with various forms of participation. In the post independence era, only a few enlightened empoloyers had on their own, initiated schemes for workers' participation in management. However, the main initiative for its popularisation came from the government. The first major step was the enactment of the Industrial Disputes Act, 1947. Further, the concept of participative management was elaborated in the Industrial Policy Resolution, 1956 which led to the launching of the scheme of Joint Management Councils in 1957.

The Industrial Disputes Act, 1947, provides for the setting up of works Committees in units employing more than 100 workers. The representatives of the workmen, whose number shall not be less than the number of representatives of the employer, are to be chosen among the workmen engaged in the establishment and in consultation with their registered trade union, if any. Under the Bombay Act, joint committees can be set up, but only in units which have recognised unions. The staturory backing and the help provided by the State resulted in the setting up of works committes/joint committes in a number of establishments. However, there is a general impression that these committees have not proved effective. Often the vagueness introduced in the scope and functioning of the committees came in the way of their effectiveness. The Indian Labour Conference in 1959 tried to remove this difficulty by drawing up a list of items,* which these works committee would normally deal with as well as the list of items, which would be beyond their purview. Although these clarifications about the scope were generally helpful but

*(i) Conditions of work such as ventilation, lighting, temperature and sanitation including latrines and urinals;

(ii) amenities such as drinking water, canteens, dining rooms, medical and health services;

(iii) safety and accident prevention, occupational diseases and protective equipment;

(Iv) adjustment of festival and national holidays;

(v) administration of welfare and fine funds;

(vi) educational and recreational activities;

(vii) promotion of thrift and savings; and

(viii) implementation and review of decisions arrived at in the meetings of works committees.

there were numerous other difficulties. Commenting on this, the National Commission on Labour has remarked that according to the views expressed by the State Governments—"advisory nature of recommendations, inter-union rivalries, union opposition and reluctance of the employers to utilise such media have rendered works committees ineffective". The Employers' Associations have attributed the failure of the works committees to factors like inter-union rivalries, union antipathy and the attitude of the members (workers' wing) in trying to raise in the committee discussion on extreneous issues. On the other hand, trade unions maintained that "conflict between the unions jurisdiction and the jurisdiction of the works committees and the unhelpful attitude of the employer have generally led to their Failure."[1] Whatever may be the views of the employers' and workers' organisations on the effectiveness of the works committees, the fact remains that both the parties did not evince sufficient interest in them.

The Industrial Policy Resolution of 30 April, 1956, besides reiterating the need for raising workers' living standards and efficiency also urged for joint consultation between management and workers in the common task of development. In this context, the Resolution states :

"In a socialist democracy, labour is a partner in the common task of development and should participate in it with enthusiasm .....There should be joint consultation and workers and technicians should wherever possible be associated progressively in management. Enterprises in the public sector have to set an example in this respect."

The Third Five Year Plan in its approach to the problems of industrial relations also laid emphasis on the policy of associating labour more and more with management and accepted the progressive extension of the scheme of Joint Management Councils as a major programme. The Pian recommended the setting up of Joint Management Councils in all industrial undertakings found suitable for the purpose so that in due course of time the scheme might become a normal part of the industrial system. The main purpose of the setting up or Joint Management Councils was to promote cordial relations between management and workers, build up understanding and trust between them, effect substantial increase in the productivity, secure better welfare and other facilities for workers and train them to understand and share the responsibilities of the management.

(1) Report of the National Commission on Labour, Para-24.4.

The essential functions of the Joint Management Councils are as under:

(i) Council/councils would be consulted by the management on matters like standing orders, retrenchment, rationalisation and closure, reduction or in cessation of operation.

(ii) Council/councils would also have the right to receive information to discuss and give suggestions on (a) general economic situation of the concern, (b) the state of the market, production and sales programme, (c) organisation and general running of the undertaking (d) circumstance affecting the economic position of the undertaking, (e) methods of manufacture and work, (f) the annual balance sheet and profit and loss statement and connected documents and explanations and (g) long term plan for expansion, re-development, etc. The council was also entrusted with the administrative responsibility in respect of welfare and safety measures, etc. Issues relating to wages, bonus etc., which are subjects for collective bargaining are excluded from the scope of the councils. Individual grievances are also excluded from the purview of the discussion.

Despite the useful purpose the Joint Management Council serves, it has been observed by the National Commission on Labour that in many cases the councils were reported to be ineffective and their functioning unsatisfactory. The scheme was adopted by only a limited number of undertakings in the public and private sectors. The reasons for their unsatisfactory working were: (i) representatives of Central Organisation of employers and workers supported the scheme at national level but have shown inadequate interest in making their affiliates enthusiastic about it, (ii) employers who already had the system of consultation with their workers in the form of works committees and the recognised union find the Joint Management Councils in their present form quite superfluous. Managements are generally averse to having a multiplicity bipartite consultative arrangements at the plant level and so are the unions. The scheme of code of discipline and model grievance procedure, which were evolved to ensure industrial peace met with very little success due to indifference on the part of management and unions.

It may thus be seen that despite the setting up provision of works committees and joint management councils, the communication

channels between labour and management remained inoperative. In many cases, the scheme existed only on paper. In the absence of communicating channels and continuous dialogue between the workers and the management the general industrial relations in the country deteriorated. The industrial relations were at the lowest ebb during 1974-75. Strikes, squatting, bandhs and ghearos were the common features. Frequent hikes in wages not commensurate with the production and productivity were demanded. In precise, the entire industrial economy was presenting a dismal picture. No developing nation can afford the luxury of industrial disharmony, which inevitably puts strain on production and productivity. This in turn affects the national growth adversely. With the 20-point economic programme the workers' participation in management has once again become an important issue. The then Prime Minister observed:

"..... there is only one way which can remove poverty and that is hard work sustained by clear vision, with will and the strictest discipline...." She demanded from the leaders of the trade unions and industry "to maximise production and productivity with utmost sense of urgency." In this direction she suggested that the workers' participation in the industry particularly at shopfloor level to the board of directors may be encouraged.

The scheme of workers' participation in industry at shop-floor level was endorsed in the State Labour Ministers' Conference held on 19th July, 1975. The Conference also recommended that immediate steps may be taken to give it a statutory shape. As a result of these efforts, the Union Government came out with a new scheme of workers' participation at the shop and plant level.

Creation of a new machinery at shop-floor and plant level has been basically suggested with a lone purpose of increasing production and productivity. However, this arrangement will inevitably restore the industrial relations and induce workers' to co-operate fully with the management in the day-to-day affairs of the enterprise. The scheme proposes to bring within its ambit industrial enterprises in public, private and co-operative sectors, including departmentally run undertakings. The scheme has been kept flexible so that it may mould itself according to the needs of local conditions. Implementation of the scheme would be made through an Executive action, even the possibility

of giving it a statuory shape in future has not been ruled out. The scheme has been made voluntary but due to the initiative of the Government its introduction is likely to receive due importance. The main features of the scheme are as follows:

(1) In every industrial unit employing more than 500 persons, the employer will constitute a shop council for each department or shop or one council for more than one department or shop, considering the number of workers employed in different departments or shops. Each council will have equal number of representatives from workers and management side. Management will nominate employer's representative and worker's representative will be picked up from amongst the workers engaged in the concerned shop or department of the enterprise;

(2) The number of shop councils and departments to be attached to each council of the undertaking will be decided by the management in consultation with the recognised unions or various registered trade union or with workers, as the case may be, in the manner best suited to local conditions. The number of members of each council may also be determined in the same manner, but the total number of members, however, may not generally exceed 12;

(3) All decision of the council will be on the basis of *consensus* and not by process of *voting*, provided that either party may refer unsetted matters to the Joint Council for consideration. Each decision of the shop council will be implemented by the party concerned within one month, unless otherwise specified;

(4) The decisions having a bearing on another shop, or the undertaking or establishment, as a whole will be referred to the Joint Council for consideration and approval;

(5) A shop council once formed will function for two years. It will meet as frequently as necessary and at least once a month.

(6) The Chairman of the shop council will be a nominee of the management and the Vice-Chairman will be elected by the worker members of the council from amongst themselves. The main purpose of shop councils is to assist the management in achieving monthly and yearly production targets, improving production, productivity and efficiency

including elimination of wastage and optimum utilisation of machine capacity and manpower. It will also be their function to identify areas of low productivity and take necessary corrective measures to eliminate relevant contributing factors, study absenteeism and render assistance in maintaining general descipline in shop and departments. These council should ensure proper flow of an adequate two-way communication between the management and the workers, particularly in matters relating to production figures, production schedule and progress in achieving targets.

There is a provision in the scheme to set up a Joint Council for the plant as a whole. Its membership will remain confined to those who are actually engaged in the unit. The Chief Executive of the unit will be the Chairman of the Joint Council and Vice-Chairman will be nominated by the worker members of the council. One of the members of the council will be appointed as Secretary. The Joint Councils, will be setup for a period of two years and meet at least once in every quarter. Every decision of the Joint Council will be implemented within one month, unless otherwise specified. The Joint Councils will deal with matters relating to optimum production, efficiency and fixation of productivity norms for man and machine for the unit as a whole, development of skills of workmen and adequate facilities for training, preparation of schedules of working hours and holidays, awarding rewards for valuable and creative suggestions received from workers, optimum use of raw-materials and quality of finished products and general health, welfare and safety measures of the unit. Besides, dealing with work planning and achieving production targets, the issues pertaining to salary scales, bonus-profit sharing etc., have been kept outside the purview of discussions in shop or joint councils. These matters will continue to be settled through the process of collective bargaining between the management and the recognised trade unions.

The need to coordinate shop-floor and enterprise, workers' participation with the representative of employers and trade unions on national basis is obvious. In an increasingly complex society it may not be appropriate of possible to take decisions on many matters at shop or plant level and must be left for higher authority. It is in this background, a 22 member National Apex Body comprising both employers and workers has been setup by the Union Government. The Apex Body will explain the underlylng philosophy of the scheme to workers and managements

for their acceptance and adoption in the private sector. Centre has advised the State Governments to set up Advisory Committee headed by the Chief Ministers to ensure speedy implementation of the new scheme and directed public sector undertakings to setup shop councils and joint councils, as envisaged in the Scheme, within three months. A number of sittings of National Appex Body have since been arranged. In the meeting held on 10th January, 1976 it was observed that several state governments have setup Apex Bodies on the pattern of the National Body to deal with the labour problems at the state level. The state government who had not yet set up Apex Body at state level were asked to do so immediately.

Both employers and employees have responded enthusiastically to the new scheme. In whichever unit this has been implemented in letter and sprit, production has considerably increased, optimum utilisation of man and machine and raw-materials has been made and the 'waste' has been minimised. Above all, the industrial relations in the enterprise are fast moving towards cordiality. The implementation of the scheme in State, public sector and private sector industries has gathered momentum. By now the Scheme has been implemented in 18 Central Government Undertakings, 141 Central Government Public Sector Units in the manufacturing sector and 224 collieries under the Coal India Ltd. In respect of departmental undertakings the scheme has been implemented in 3 Government mints, 3 Telecommunication factories, 2 Government Presses, 7 Ordinance and 3 Railway factories. As regards State Governments, Andhra Pradesh has implemented the Scheme in 56 units, Gujarat 91, Haryana 42, Madhya Pradesh 43, Maharashtra 81, Tamil Nadu 179 and Karnataka 16, Uttar Pradesh in 146, Delhi 6, Goa 1, Jammu and Kashmir 1, Himichal Pradesh 2, Chandigarh 3, Andaman and Nicobar 2, Bihar 72, and Rajasthan 32. The State Government of Punjab has extended the Scheme to units employing 200 workers. Similarly, 20 units in Bihar not covered under the Scheme have implemented it. About 16 programmes were conducted by the National Labour Institute, Delhi for participative management for Industrial Managers. In these programmes 503 industrial managers partlcipated. A few workshops on Participative System in the management were also arranged.[2] In addition, the Centre has already appointed workers' on the board of management in some public sector undertakings like

2 Indian Workers, Independence Day Number, August, 1976, page 24.

Hindustan Antibiotics and Hindustan Organic Chemicals, etc. The nationalised Banks too have workers on the Boards of Directors. Joint Management Councils with vide ranging powers, have been set up in all the units under the Fertiliser Corporation of India.

From the foregoing discussion, it is evident that the scheme of workers' participation at shop and plant level has made a good beginning. By now, a large number of establishments in public and private sectors have implemented the scheme. The industry is expected to derive numerous advantages from the scheme in the form of increased production and productivity, development of skills among workmen and the creation of adequate facilities for training, elimination of waste of raw-material, improvement in the quality of finished products, decline in the absenteeism rate, full utilisation of capacity of machine and man-power, and above all cordial relationship between the labour and management, etc. The scheme, *inter-alia* provides for the formulation of suitable measures for the welfare and safety of workers and maintenance of discipline at the shop-floor and at the plant level. Both labour and management will develop a sense of mutual co-operation and trust and would view each others problems with greater under-standing and sympathy. The communicating channels at shop and plant level will bring psychological satisfaction to the worker from his work. The worker would also develop a sense of emotional involvement and belonging to the enterprise which in turn will affect his motivation and morales.

One of the essential conditions for effective participation in management is the provision to workers and their representatives of technical know-how and understanding. This inevitably calls for a solid and effective training system for workers and their representatives. As far as the Industry is concerned it already posseses qualified, experienced and trained personnel at all levels. In their case intensive training may perhaps not be necessary. Informal meetings, seminars and workshops may be arranged to popularise the scheme. The consensus emer-ging at such meetings. seminars and workshops can be helpful to the authorities in the proper implementation of the scheme. For securing active and fruitful participation it may be necessary to bring about radical changes in the attitudes and approaches of the labour and management.

A stage has now reached when both must shed their old views, traditi-onal approaches and they must adopt a more progressive outlook,

moderate and sympathetic considerations for each others interest based on the concept of mutual cooperation and brotherhood. The employers on their part should be willing to share the secrets of their trade and technical know-how with the workers. In no case this may be regarded as an abdication of power or encroachment of labour on their managerial/administrative prerogatives. The employers would do well to encourage the workers to shed their reservations and to come forward with their ideas and suggestions, accept and implement them if they are in the interest of enterprise. The extent to which management can go in sharing the power and know-how will make the new participative system more effective and meaningful. In the words of Keith Davies, "Human relations is integration of people in to a work situation that motivates them to work together productively, co-operatively and with economic, psychological and social satisfaction."

The measures adopted by the Government prior to the promulgation of emergency in respect of workers' participation in management could not prove effective largely due to lack of interest on the part of workmen and management. Now that the necessary climate of discipline and unity in the ranks and file of working class and Industry has been created, it will be appropriate to utilise this opportunity fully for the success of the scheme. Besides, the conducive climate may also be encashed for boosting the country's production onwards and upwards. The concern of the Government in this regard is apparent in the declaration of the new Scheme of participative management and by adoption of some other measures affecting production and productivity. For exemple, a 7-day week for the private sector, lesser holidays in a year, extra-time working, linking bonus with production, productivity and profits, etc.

The Government has taken proper action at an appropriate time. Now it is the turn of the workers/trade unions and the industry to respond favourably to the call. Whatever apprehension and fears the management and workers are having on the question of participation in management those must be thrashed out. Any effort on the part of the disruptive forces that are inconsistent with the Scheme of participative management must be resisted. Growth with stability and social justice demands that any Scheme which seeks to provided communicating channels between the employers and employees, leading to cordial industrial relations and higher production and productivity must win complete success. □

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Evaluation of Performance of Different Makes of Rice Mill Components

A. S. Bakshi A. P. Bhatnagar*

Modernisation means adoption of the processes and equipments which contribute to the maximisation of yield of the main as also the by-products and/or obtain higher prices for them through improvement in quality. With the advances in science and technology, new processes are being evolved to achieve objective of modernisation.

Rice milling industry in India has been undergoing the process of modernisation. Ingellburg hullers, which were introduced in India 80 years back, marked a revolutionary change over the hand-pounding processes and did find wide spread acceptance throughout the country-side. About 45 years back the Disc sheller system came to India. This technique represented considerable improvement over the pre-existing hullers, because it yielded much higher yield of head as well as told rice and also made available pure rice bran which could not be recovered in the huller system. The rubber roll sheller system, which was evolved some 25 years ago and had obtained widespread acceptance in the developed countries, came to India only a few years ago. This technique has since proved its superiority over the Disc sheller system because it substantially enhances the quantum of head rice alongwith improvement in the quality of the rice and its bran.

About one million tonne of paddy is being processed annually in Punjab. Some years ago, Punjab was not a rice producing state, but now, due to the evolution of high-yielding varieties and with more area under paddy production, it makes a significant contribution to the central pool. The increased production has led to the establishment of a large number of rice mills. Some of the machinery which is ill designed and manufactured by local manufacturers, results in loss of head yield.

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There has been no independent study in Punjab to bring out clearly the losses which are accruing due to outmoded milling equipment and processes, bad mill management, ill-designed machinery manufactured by local manufacturers in the final product quality and by-product quality. The present study has been designed to generate data based on the indigenous equipment and processes and to compare these with the improved machines and processes. It will help the mill owners in proper running of the machines by imparting them the knowledge of proper selection, adjustments, maintenance and repair of the mills. The study will also help the manufacturers by identifying the design and manufacturing defects in the rice mill equipment. The state government and public agencies dealing with rice mill modernisation programme will be benefitted by acquisition of data pertinent to local miils and local rice varieties and local conditions on which a rational approach to the problem can be based.

Method and Materials

The study envisages comparison of the performance of rice mill component machinery which is locally manufactured with that of other machines. The various treatments were :

(I) Completely locally designed and fabricated mill (L).

(II) Indian version of foreign-make mill (IF).

(III) Foreign-made mill (F).

The observations recorded included analysis of material going in and coming out of each component of mill like foreign matter, paddy brokens, husk fractions, etc. These samples were taken each after one hour interval and all mixed together for analysis for study of performance of mill component.

The performance index of each machine in the process was calculated on the basis of methodology suggested by Rama Rao & Chandra (1973)[1].

1. Rama Rao, V. V. and P. K. Chandra (1973) : Methodology for Evaluating the Performance of Rice Mill Components, *Journal of Agricultural Engineering*, X (2), 9-12.

The relationships are given below :

Cleaner Index (C.I.) :

$$C.I = \frac{M_{cp}\ (X_{df} - X_{dp})}{M_{cp}\ X_{df}}$$

M_{cp} : Mass rate of flow absolute clean paddy in the feed or in product, kg/min.

X_{df} : Fraction of dockage in the feed with respect to absolute clean paddy.

X_{dp} : Fraction of dockage in the product with respect to absolute clean paddy.

Sheller Index (Sh. I.) :

$$\text{Shelling effectiveness, esh} = \left\{ \frac{(1-X_{pp}\ M_{sp})}{M_{pf}} \right\}$$

$$\text{Effectiveness of getting head rice, eh} = \frac{X_{sp}\ M_{sp}\ (1-X_{ph})}{M_{rf}}$$

$$\text{Sh. I.} = \text{esh. eh}$$

M_{pf} : Mass rate of flow of paddy fed to the sheller, kg/min.

M_{sp} : Mass rate of flow of shelled rice, unshelled paddy and brokens from sheller, kg./min.

M_{rf} : Mass rate of flow of head rice that could be obtained from feed to the sheller, kg/min.

X_{pp} : Fraction of unshelld paddy in the product from sheller.

X_{bp} : Fraction of broken rice in the shelled rice from sheller.

X_{sp} : Fraction of shelled rice in the product $= (1-X_{pp})$

Separator Index (S. I.) :

$$S.\ I. = \left\{ \frac{S.P.X_{ss}\ (1-X_{sp})}{(S+P)^2 X_s\ (1-X_s)} \right\} \times \left\{ 1 - \frac{M}{s+p+M} \right\}$$

$$X_s = \frac{(S+P+M)\,X_{sf} - MX_{sm}}{S+P}$$

S : Mass flow rate of shelled rice, kg/min.

P : Mass flow rate of unshelled paddy, kg/min.

M : Mass flow rate of mixture, kg/min.

X_{sf} : Fraction of shelled rice in the feed.

X_{sp} : Fraction of shelled rice in the separated paddy fraction.

X_{ss} : Fraction of shelled rice in the rice fraction.

X_{sm} : Fraction of shelled rice in the mixture fraction.

Polisher Index (P.I.) :

$$P.I. = \frac{M_p\ (1-X_p)\ (1-X_b)}{\{M_f - M_b\ (1-X_b)\}\ (1-x_f)}$$

$$\text{Percentage Polish} = \frac{M_b\ (1-X_b)}{M_f} \times 100$$

M_f : Mas rate of flow of shelled rice fed to the polisher, kg/min.

M_p : Mass rate of flow of polished rice from the polisher, kg/min.

M_b : Mass flow of bran and broken, $= M_f - M_p$

X_f : Fraction of brokens in the shelled rice (feed)

X_p : Fraction of brokens in the polished rice (product)

X_b : Fraction of brokens in bran sample

Grader Index (G.I.) :

$$G.I. = \frac{\frac{M_h\ X_{bh}}{X_{bf}} + \frac{M_b\ X_{hb}}{1-X_{bf}}}{M_h + M_b}$$

M_h : Mass flow of head rice from the head of rice of outlet. kg/min.

M_b : Mass flow of separated brokenes from the broken outlet, kg/min.

X_{bf} : Fraction of brokens in the feed.

X_{bh} : Fraction of brokens in the sample from head rice outlet.

X_{hb} : Fraction of head rice in the sample from broken outlet.

Rice Mill Performance Index :

$$M.\ P.\ I. = C.I \times Sh.I \times P.I. \times GI.$$

Results and Discussion

Results are given in Tables 1 to 4. Tables 1 to 3 give the physical analysis of incoming and outgoing samples from each component of rice mill. Table 4 gives the performance index of components of rice mill and degree of polish.

Cleaner : 6.12 percent of paddy was coming with dockage of 'L' rice mill, whereas it was 3.1 and 1.2 in case of 'F' and I F mill. The dockage from 'L' mill was again separated for paddy. Some part of dust was being mixed within the inside of mill premises of 'L' rice mill, which caused mild suffocation and choking. The performance indices of 'IF', 'F' and 'L' mills were 0.98, 0.51 and 0.48 respectively. When the paddy cleaner is able to remove all the dockage that is present in the paddy, the C. I. should be unity. However, in all mills it was less than unity, showing thereby that whole of the dockage was not being removed. One of the reasons for low C. I. in case of 'L' and 'F' mill was that dockage in input paddy was only 4.1 and 2.25 percent, whereas in 'IF' mill it was 13.37. It is difficult to remove all the dockage present, so the initial low values of dockage resulted in low C. I. value.

Sheller : Percentage breakage was about 1, 5 and 7 in 'I F', 'F' and 'L' mills respectively. The 'F' rice mill gave the high shelling index i.e. 0.86, whereas it was 0.42 and 0.32 in the case of 'I F' and 'L' mill. The shelling index should be unity if there is no unshelled paddy, and breakage during shelling should be zero. Actually, however, there is always some amount of unshelled paddy and some breakage. One of the reason for this could be that the gap between rubber rolls is

adjusted for average size of paddy. The paddy kernel larger than the average size may result in breakage and lesser one may not be shelled. Besides this, there could be other reason like heating of rubber rolls, speeds of rubber rolls less or more than recommended, moisture content of paddy less than 14 percent, etc.

Separator : Ideal separator is one in which whole mixture of paddy and shelled rice is separated completely i.e., there is no paddy in the sample from the shelled rice outlet and no rice from the paddy outlet and also there is no unseparated mixture. However, in the present study, the percentage of paddy in shelled rice outlet was 1.0, 2.9, 5.2 and rice in paddy outlet was 6.5, 8.5, 16.3 in 'I F', 'F' and 'L' rice mills respectively. The separator index was 0.83, 0.25 and 0.28 in 'I F', 'F' and 'L' mill respectively,

Polisher : The grader should separate the whole rice and brokens in such a way that there should not be any mixing of the two. But it is difficult to achieve the ideal condition. The percentage of brokens was 14.05, 16.45, and 18.46 in 'I F', 'F' and 'L' mill. The grader of 'F' rice mill gave the lowest grader index i. e. 0.29, whereas the 'I F' and 'L' gave 0 85 and 0.45.

Conclusion

The overall performance of locally-made mechinery was the poorest. One of the reasons could be that this machinery was manufactured on designs based on hit and trial method. The manufacturer tried to fit whatever parts were available. The foreign-made machinery also gave poor performance. This could be attributed to the fact that this machierny was imported and installed about four years ago with limited quantities of spare parts. Whenever a part got broken, the same was replaced with a locally-fabricated one in most of the cases. These locally-made parts did not match with the original parts in quality and performance and resulted in the poor performance of the original foreign-made machinery. The rice mill adopted from foreign make mill gave the best performance as it was designed for Indian condition with scientific design and not by hit and trial method. However, it can be said that management played an important role in performance of machines.

Table 1 : Physical Analysis of Samples from 'I.F.' Rice Mill.

Sl. No.	Sample	Dockage %	Brokens %	Paddy %	Rice %	Husk %	Remarks %
1.	Input to cleaner	13.37	Nil	86.63	Nil	Nil	
2	Output of cleaner (cleaned paddy)	0.33	Nil	99.68	Nil	Nil	
3.	Output of cleaner (Dockage)	98.80	Nil	1.20	Nil	Nil	
4.	Input to sheller	0.30	0.16	99.36	Nil	0.16	
5.	Output of sheller	Nil	1.20	15.40	79.3	4.10	
6.	Input to separator	Nil	1.20	15.40	79.3	4.10	
7.	Output of separator (Rice)	Nil	1.00	1.00	97.80	0.20	
8.	Output of separator (Paddy)	Nil	1.10	92.35	6.5	0.05	
9.	Input to polisher	Nil	1.00	1.00	97.80	0.20	
10.	Output of polisher (Rice)	Nil	19.30	Nil	79.40	1.30	
11.	Output of polisher (Bran)	Nil	1.30	Nil	Nil	4.00	Rest Bran
12.	Input to grader	Nil	19.30	Nil	79.40	1.30	
13.	Output of grader (Final product)	Nil	14.05	Nil	85.95	Nil	
14.	Output of grader (Brokens)	Nil	98.46	Nil	1.54	Nil	

Table 2 : Physical Analysis of Samples from 'F' Rice Mill

Sl. No.	Sample	Dockage %	Brokens %	Paddy %	Rice %	Husk %	Remarks
1.	Input to cleaner	2.25	Nil	97.55	Nil	Nil	
2.	Output of cleaner (cleaned paddy)	1.10	0.13	98.77	Nil	Nil	
3.	Output of cleaner (Dockage)	96.39	0.11	3.10	Nil	Nil	
4.	Input to sheller	1.10	0.50	98.40	Nil	Nil	
5.	Output of sheller	Nil	5.20	39.60	55.20	5.20	
6.	Input to Separator	Nil	5.20	34.60	55.20	5.20	
7.	Output of Separator (Rice)	Nil	4.10	2.90	92.50	0.50	
8.	Output of Separator (Paddy)	Nil	2.00	89.40	8.50	0.10	
9.	Input to polisher	Nil	4.10	2.90	92.50	0 50	
10.	Output of polisher	Nil	23.10	Nil	76.90	Nil	
11.	Output of Polisher (Bran)	Nil	6.10	Nil	Nil	9.30	Rest Bran
12.	Input to grader	Nil	23.10	Nil	76.90	Nil	
13.	Output of grader (Final product)	Nil	16.45	Nil	73.55	Nil	
14.	Output of grader (Broken)	Nil	95.90	Nil	4.10	Nil	

Table 3 : Physical Analysis of Samples from 'L' Rice Mill.

Sl. No.	Sample	Dockage %	Broken %	Paddy %	Rice %	Husk %	Remarks
1.	Input to cleaner	4.10	Nil	95.90	Nil	Nil	
2.	Output of cleaner (Cleaned paddy)	2.10	0.61	97.29	Nil	Nil	
3.	Output of cleaner	93.37	0.51	6.12	Nil	Nil	
4.	Input to sheller	2.00	0.73	93.27	Nil	Nil	
5.	Output of sheller	Nil	7.80	37.20	53.00	2.00	
6.	Input to separator	Nil	7.80	37.20	53.00	2.00	
7.	Output of separator (Rice)	Nil	6.20	5.20	88.60	1.00	
8.	Output of separator (Paddy)	Nii	0.50	81.60	16.30	2.10	
9.	Input to polisher	Nil	6.20	5.20	88. 0	1.00	
10.	Output of polisher (Rice)	Nil	28.20	Nil	71.80	Nil	
11.	Output of polisher (Bran)	Nil	4.10	Nil	Nil	3.10	(Rest Bran)
12.	Input to grader	Nil	28.20	Nil	71.80	Nil	
13.	Output of grader (Final product)	Nil	18.46	Nil	81.54	Nil	
14.	Output of grader (Broken)*	Nil	94.70	Nil	5.30	Nil	

Table 4 : Performance Index of Components of Rice Mills.

Component	Performance Index			Degree Polish		
	F	IF	L	F	IF	L
Cleaner	0.51	0.98	0.40			
Sheller	0.42	0.86	0.32			
Separator	0.25	0.83	0 28			
Polisher	0.74	0.82	0.72	5.29	3.52	7.54
Grader	0.29	0.85	0.45			
Overall Mill	0.014	0.58	0.018			

Table 5 : Biochemical Analysis of Rice Bran Samples from Rice Mills.

Rice Mill	Total fat %	Grade protein %	Moisture content
F	16.10	17.39	8.45
IF	21.35	16.52	8.90
L	14.81	16.73	9.20

F Values for the year 1974-75. IF, L Values for the year 1973-74.

Optimal Procurement and Inventory Policies for Drugs in a Hospital

Prem Vrat A. B. Khan*

A hospital system is a concentration of resources, assembled for the purpose of providing the means by which medical care is administered to the sick and the injured. A public hospital is a non-profit, community supported, humanitarian enterprise having the characteristics of a socio-economic service system. Since the needs of community for health care have considerably increased, the hospital systems have to be managed more efficiently to maximise the effectiveness of patient care within the constraints imposed by the financial, social and professional environment.

A cost-benefit approach would reveal that the objective of improved effectiveness of health care and restoration must be achieved by efficient utilisation of hospital resources. The trend of rising costs for medical attention has alarmed the general public and under the conditions, it becomes all the more important to take a systems approach to hospital planning and management. It is in this context, that hospital systems provide an excellent oppurtunity for the application of productivity techniques.

From the conceptual viewpoint, there exists a good degree of analogy between the industrial service systems and the hospital systems, so that the techniques so widely being applied for the efficient management of industrial service systems can be extended to cover the hospital systems. For example, there is a one to one correspondence between the maintenance of machines and equipment in an industrial context with the maintenance of health of human beings requiring medical attention. Hence, all the concepts in maintenance management including preventive maintenance can possibly be extended to this area of socio-economic service system. But the problem of maintenance of health is more challenging than maintenance of machinery because of the social, psychological and the public-relation environment within which a hospital system has to function. The degree of uncertainity

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is probably more in the administration of health maintenance system than a machine-maintenance system, because in addition to other things, the doctor plays an important role as some policies can be influenced, shaped or even vetoed by him for 'medical reasons', which the hospital administration may be unable or unwilling to challenge or reject. Thus it is more challenging to plan decisions on rational basis in a hospital system than any analogous industrial service system.

In this paper, a case study has been reported where the inventory and procurement aspect of drugs required for medical attention and health care have been attempted on a scientific basis. The problem is very challenging because of large varieties of drugs coupled with a possibility of substitute drugs, the perishable nature of the commodity stored and a very high cost of non-availability at times. These factors with added uncertainties in demand and supply of drugs make the problem of inventory management fairly challenging. Guidelines for optimal procurement and inventory policies have been given for a large public hospital in New Delhi.

Inventory Problem

To maintain an efficient level of hospital service, adequate supply of medicines and chemicals should be available from the central drug store to meet the pattern of demand by the patients. There should be a good degree of reliability of supplies in the health care system to hold the procured drugs in readiness to meet the demands from physicians and surgeons for treating the patients. Due to inherent stochastic pattern of demand for drugs, limited financial allocation for building up inventories, limited short life of certain drugs and a multiplicity of sources of procurement of drugs the basic questions to be answered by an optimal inventory and procurement policy are : "How much to procure, when and from where?"

The specific attributes make the problem of Inventory control of drugs, quite different from the industrial stores. Stockouts in a business context can be met mostly at higher cost and the cost of shortage can be measured, but in a drug store the cost of shortage cannot be measured by the same criterion; as one hesitates to put cost on the loss of human life, possibly as a result of stockout. The delay in

emergency procurements causes immeasurable discomfort and suffering to the patients and even at times loss of human life or permanent disability. Thus the "opportunity cost" cannot be easily measured in financial terms. Secondly, the needs of the community served by a hospital are quite difficult to assess fully which may cause an inaccurate estimation of expected demand and its pattern of variation, which may either lead to frequent stockouts or overstocking leading to deterioration, obsolesence and pilferage of drugs. The perishable nature of drugs and deterioration in its quality as a function of time and the possibility of a substitute drug make the procurement a permanent problem more challenging alongwith limited financial allocation for building the stocks probably due to adhoc methods of budget allocation to various sectors of hospital system activities. In addition, there exists a degree of criticality for certain drugs as against some others.

Present System

In the case reported in this paper, the existing system of procurement and inventory was studied to identify the drawbacks for possible remedial action, as well as to gain data for the design of a rational procurement and inventory system based on scientific study of various parameters affecting the system.

The medicine store was divided into following sub-stores dealing with a particular type of medicines :

(i) Antibiotic store

(ii) Injections and tablet store

(iii) Liquid and powder store

Each store was manned by a store keeper but there no proper arrangement for ventilation and control of physical environment leading to possible impotency of drugs and the inefficiency of persons working there. The Deputy Medical Superintendent was responsible for the development of the stores and the planning of inventory control policies.

Source of Supplies and Priority Index

The purchases were made from 40 suppliers with lead time, varying from 3 days to 120 days, in addition to Medical Stores Division, and the Super Bazar (for local emergency purchases). The proprietory items were procured from the manufacturers while the non-proprietory items were purchased from the supplier who quoted the lowest price. Thus the inventory and procurement system was a MIMS system (Multi-Item, Multi-Source) in Fabrycky and Banks [1] terminology.

The present policy required procurement first from Medical Stores Division (MSD) and, only upon non-availability there from the other sources. The lead time from MSD was about six months with irregularity in supplies, without ensuring lowest prices and replacement of breakages. There appeared little justification of such a preference, particularly when budget allocation for inventories was much less than the requirements. Second preference went to concerns with DGS&D rate contract which also resulted in higher lead times (4 months), lesser percentage of meeting demands, without any intimation to the purchaser and other bottlenecks and delays. Third preference went to proprietory items with an upper limit of Rs. 10,000 on the value of the order placed to them and finally the order was placed to other suppliers (about 40 in number) without considering the lead time and reliability of supplies.

This policy of procurement was neither economical nor efficient in the sense of quick replenishments and improved quality of drugs. No scientific and objective basis was tried for placing the order to the right source, keeping in mind the cost of medicines, quality, lead time, transportation cost and reliability of service.

The existing system of recording need improvement as the amount of demand was nowhere recorded and the magnitude of under-supply was not available for use in decision-making in future. The design of indent book and procedure adopted tended to increase the time spent on avoidable paper work.

Drawbacks of Existing Replenishment System

The following areas for improvement were observed upon the study of

the present system :

1. The purchase pharmacist had to work in preparing the purchase orders and forms in addition to his own work of looking after antibiotic store. Consequently, the processing of orders was taking longer time than usual.

2. No specific rule was followed to establish procurement quantity keeping budgetary constraints in mind. There was no statistical basis of demand forecasting. Moreover due to the inter-dependability among the drugs, very often the subjective estimates made regarding the expected use of drugs were highly inaccurate at times. As a result, there was acute shortage of some drugs and high unused stock of others at the same time, which neither reduced the capital blocked in inventories, nor improved the service level.

3. An *ad-hoc* rule of holding three months of average demand in inventory all the time, without indicating the reorder point for each drug was resulting in a tendency to increase the inventory and sometimes shortages due to the negligence of the store keepers in signalling for the next procurement.

4. There was no criterion for the number of orders for procurement. Whenever there was a shortage, an order was initiated.

5. The policy of not utilising the available money, when the sanctioned quota of one medicine was not procured to some other medicines caused problems which were further aggravated when the demand for a medicine dwindled due to introduction of a parallel medicine. The doctors tended to prescribe the latest medicines which could not be purchased as in the final list no sanction had been given in their favour.

Proposed System

Considering the nature of items and non-profitability motive of the system, it was felt that the conventional treatment of the inventory analysis would not be suitable in this case. The resources for building up store were sanctioned once a year and fixed for specific

items, where the demand might very well exceed the amount of units procured. Hence the situation was comparable to 'deterministic demand' system found in inventory literature where demand is analogous to "supply" of medicines. The system has been treated as "dynamic inventory system under certainty" where the significant savings can be effected by optimising the number of orders placed from a right source. In addition the procedural improvements were also suggested to eliminate or reduce the problems outlined in the proceeding sections of this paper. The surgical items and chemicals were not included in the study as there was not much fluctuation of demand in these cases. The study was divided in 3 phases as follows:

1. Demand forecasting.

2. ABC categorisation based on the criticality of the items rather than costs.

3. Ordering analysis with the help of mathematical model.

Demand Forecasting and Adjustment

The data were collected for the consumption pattern of the demand for the past three years. The individual demand pattern was studied on 60 selected drugs and it was thought to follow a normal distribution in many cases. This aspect of demand pattern, however was not considered because of the budgetary restraints. The expected demand on a yearly basis was forecast by using a second degree polynomial. The value of the demand was obtained by multiplying the unit price of the drug. A computer programme in FORTRAN-IV was developed for forecasting the demand. The total value of drugs expected to be consumed next year was estimated to be Rs. 49,31,816 but the budget allocation for the inventories was onls Rs. 39,39,000 for the planning year under consideration. To adjust for the discrepancy between demand and allocation of funds following alternatives were explored :

(i) Some medicines of low priority on criticality may not be purchased at all.

(ii) Equal reduction in value of all medicines to conform to the budgetary constraints.

(iii) Weighted reduction in the medicines where the critical drugs will carry a different reduction from non-critical ones. For the purpose of classifying drugs on this basis, an analysis similar to ABC analysis was carried out.

Criticality Analysis Based on Degree of Essentiality

The drugs were classified in 3 categories based on the criticality considerations rather than the costs and inventory value. In consultation with the management, the drugs were classified in the following 3 classes in an ABC analysis.

A—class: Very essential (*must*) drugs.

B—class: Moderately essential (*should*) drugs.

C—class: Nonessential (*may*) drugs.

The criticality was based on the essentiality of the drug in running the hospital, especially the in-patient departments. The division of ABC class obtained are shown in Table 1. The individual value of annual consumption was first multiplied by $(\frac{3939000}{4931816})$ to obtain the adjusted value of procurement forecasted values obtained previously.

Mathematical Model

Nomenclature :

c_1 = carrying cost expressed as percent 4 value of inventory per period.

c_2 = cost of ordering/order.

z_i = annual consumption of i^{th} item in units.

c_i = unit cost of i^{th} item

q_i = order quantity in units for i^{th} item.

q_{io} = optimal order quantity for i^{th} item.

x_i = value of optimal quantity in Rupees = $q_{io}\ c_i$

n_i = total no. of orders for i^{th} item/year.

t_i = sceduling period for i^{th} item.

It has been shown by Fabrycky and Banks [1] and Miller and Starr [2] and others that :

$$q_{io} = \sqrt{2z_i\ c_2/c_1c_i} \quad \ldots \quad \ldots \quad (1)$$

$$x_i = q_{io}.\ c_i = \sqrt{2z_i\ c_i\ c_2/c_1} \quad \ldots \quad \ldots \quad (2)$$

$$n_i = \sqrt{c_i\ z_i\ c_1/2c_2} \quad \ldots \quad \ldots \quad (3)$$

Total average inventory (T. I.) for all the items is given by

$$T.\ I. = \sqrt{c_2\ /c_1}.\Sigma\sqrt{c_i\ z_i/2} \quad \ldots \quad \ldots \quad (4)$$

Total no. of orders for all the items (T. O.) is given by

$$T.\ O. = \sqrt{c_1/c_2}\ .\Sigma = \sqrt{c_i\ z_i/2} \quad \ldots \quad \ldots \quad (5)$$

Thus (T. I.) x (T. O.) = $\frac{1}{2}\ (\Sigma\sqrt{z_i\ c_i})^2$ = constant for all-optimal policies ... (6)

$$\frac{T.\ I.}{T.O.} = (c_2/c_1) \quad \ldots \quad \ldots \quad (7)$$

Thus for a given T·I. and T.O., the ratio of (c_2/c_1) upon which the optimal policy is based can be determined. This suggests a very powerful device to establish inventory policies under circumstances where satisfactory estimates of relevant costs are avaliabe. This is obtained by the "*optimal policy curve*" which is a rectangular hyperbola because the product of T. I. and T.O. is constant for all optimal policies for any combination of c_1 and c_2. Every point on the curve presents an optimal policy for a particular ratio of (c_2/c_1) given by (T.I./T.O.). The performance of the system can be improved by either fixing average investment in inventories and then fixing T.O. from the optimal policy curve, or *vice-versa*. The optimal policy curve shows exactly how orders and inventory investment can be treated; one for the other.

Multiple Items from One Supplier

If a supplier quotes the lowest rates for a group of items (say N) then these can be procured from one source. The total rupee demand z_c is given by

$$z_c = \sum_{i=1}^{N} z_i\, c_i \qquad \ldots \quad \ldots \quad \ldots \quad \ldots (8)$$

It can be easily seen that the optimal policy should have same scheduling period for all the items to reduce the total cost. The optimal scheduling period 't' by considering all the items as a unit (stored in different shelves) is given by

$$t = \sqrt{2c_2/c_1 z_c} \qquad \ldots \quad \ldots \quad \ldots \quad \ldots (9)$$

An item with low rupee demand can be ordered less frequently, may be ordered at an interval of 'j.t' where j is an integer multiplier. If c_f is the fixed cost of an order, then review cost will be $h.c_f$ where h can be asaumed to be constant for all items in the group. If the item D has a rupee demand of $z_D\, c_D$ then the minimal multiplier j can be found out by the relationship given by Miller and Starr [2] as follows;

$$\frac{z_D\, c_D}{z_c} < \frac{h}{(j-1).j.(1+GN)} \qquad \ldots \quad \ldots \quad \ldots \quad \ldots (10)$$

Number of orders to a supplier :

It can be shown that,

$$(\text{Min.T.C.})_i = \sqrt{2c_1\, c_2}.\ \sqrt{z_i\, c_i} \qquad \ldots \quad \ldots \quad \ldots (11)$$

$$\Sigma\ (\text{Min.T.C.})_i = \sqrt{2c_1 c_2}.\ \Sigma\ \sqrt{z_i\, c_i} \qquad \ldots \quad \ldots \quad \ldots (12)$$

and

$$\frac{(\text{Min. T.C.})_i}{\Sigma(\text{Min. T.C.})_i} = \frac{\text{optimal no. of orders for } i^{th} \text{ item}}{\text{optimal total no. of orders}} = \sqrt{z_i\, c_i} / \Sigma \sqrt{z_i\, c_i} \qquad \ldots \quad \ldots \quad \ldots (13)$$

$$= \frac{\text{optimal av. Investment in inventory of } i_{th} \text{ item}}{\text{optimal total av. inventory investment}} \quad \ldots \quad \ldots \quad (14)$$

From this the optimal number of order to the i_{th} supplier can be computed for the given average inventory investment.

Solution Procedure

Following algorithm can be used for finding the optimal inventory policies :

1. Forecast the future annual requirments by least square polynomial curve.
2. Adjust the forecast according to budget constraints and criticality division.
3. Arrange the drugs to be purchased from one supplier in a group and compute the value of purchase from each supplier.
4. Obtain the fraction of total orders for each supplier from equation (13)
5. Compute integer muitiplier 'j' for each drug and compute the scheduling period as 'j.t'.
6. Determine the average investment in inventories for various values of total orders.
7. Draw the optimal policy curve.
8. Find the optimal orders from the optimal policy curve for a calculated ratio of (c_2/c_1) and a given total average investment in inventories.

Results of Ordering Analysis

A computer programme was written to handle the calculations for ordering analysis on the assumption that the materials were to be purchased only from the listed suppliers. Since a maximum value of an order was laid down to be Rs. 10,000, the total number of orders that could be placed was about 393.9 say 400/year. Thus total no. of orders per year were tried from 350 in steps of 50 for 12 steps and the average

inventory investment was calculated from the following relation :

$$\text{Av. inventory/supplier} = \frac{\text{Total annual value of purchase}}{\text{2x no. of orders placed}}$$

A sample of the computer printout of percent of total orders annually placed to each supplier is shown in Table 2. For example for supplier (if no. of orders to be placed is 680/year,) the total no. of orders to this supplier is 18 and a scheduling period of 2.8 (say 3) weeks. The details of orders for this supplier are shown in Table 3. Such a table is prepared for all suppliers. Fig. 1 shows the optimality curve, which is a plot between total average inventory and the total no. of orders/year. The carrying cost C_1 was taken to be 14 percent of the drug cost/year after discussing with the management. The cost of ordering was estimated by the cost of manpower, correspondence, stationary and transportation, etc. over a certain period and c_2= Rs. 20.8 order was the figure estimated. This gave $(c_2/c_1) = 148$ and corresponding points on the optimality policy curve gave the following information :

Total average inventory = Rs. 100,000

Total optimal no. of orders = 680/year

At present the number of orders placed are 860/year for which the optimal inventory investment on an average should be Rs. 80,000 (form the optimal policy curve). Alternatively, an order of 800/year will be optimal only ifc c_2/c_1) ratio is 93 which imputes the cost c_2=Rs. 13.00/ order.

Results and Other Recommendations

The above procedure provides a means to judge the total cost of the inventory systems without indulging in the inaccurate method of computing the carrying and the ordering costs. The optimal policy curve also provides means for treading for inventory investments. If one cost parameter (c_1 or c_2) can be measured, then the imputed value of the second can be obtained which can be a quick check on

the optimality of the policy under use. The quantity of each drug to be ordered from each supplier is found out by identifying the supplier and the optimal scheduling period. It was felt to recommend that the procurement be made from open market at competitive lowest rates rather than procuring from MSD or suppliers with DGS & D rate contract; as it is not only time-consuming and costlier but also has higher degree of uncertainity in supplies with much longer lead times. The entire ordering analysis was carried out with the help of a computer programme developed to tackle the large number of drugs of various varieties.

In addition, improvements were also suggested for staffing pattern in stores; information collection through improved forms; streamlining the procedures and reducing the processing time; and making the information retrieval much faster to improve the quality of decision. Additional form was designed to collect and update the suppliers behaviour pattern in terms of reliability and lead-time and the number of orders placed/year alongwith the quality and extent of order realisation. This would provide a ready reference for planning of purchases in future from the best source. In addition, improved system of record-keeping was suggested by improving the design of the purchase requisition forms, stock register and introduction of colour codes for case of differentiating. An additional receipt and inspection register and the form was suggested to give the record of inspection carried out before accepting and rejecting the drugs. This will give a record of the percent rejections due to poor quality of drugs supplied.

Conclusion

The study reported in this paper attempts to streamline the procurement and inventory control of drugs and gives guidelines for optimal policy under a set of conditions. The study had limitations as the stochastic demand pattern and lead-time could not be considered due to the budget constraint. The price breaks offered for bulk supply and evaluation of single-source supplies *versus* multiple-source supplies could not be tried. However, the paper identifies important problems in the area of hospital systems. The specific artributes of the problems are highlighted. A very limited amount of work is reported in the existing literature for the type of situations encountered in this paper.

Table 1 : Criticality Analysis in Drug Stores

Total No. of drugs=375

S. No.	Store	No. of drugs in various classes				% of inventory value in various classes			
		A	B	C	Total	A	B	C	Total
1.	Antibiotics	20	22	5	407	67	32	1	100
2.	Injections	57	47	11	115	80	15	5	100
3.	Liquid	6	40	6	52	38	58	4	100
4.	Tablets	8	91	14	113	30	66	4	100
5.	Powder	5	38	5	48	34	63	3	100

Table 2

Supplier No.	Percentage of total orders annually placed	Annual value of suppliers in Rs
1	2.83	108717
2	2.30	71845
3	0.71	693
4	1.43	27814
5	1.42	27448
6	1.45	28479
7	1.26	21677
8	1.08	15868

Table 3

Supplier No.=1

Annual Value of Sales=Rs. 108,717 No. of order=18

Total no of orders in the system=680/year

h=0.05 No. 10

Code of drug	*Value of purchase (Rs.)*	ZiCi/Zc	j	*Scheduling period (weeks)*
9.10	51180	0.470	1	3
11.1	3840	0.035	2	6
12.1	3725	0 034	2	6
13.1	22803	0.209	1	3
72.2	2664	0.056	1	3
39.3	13327	0.122	1	3
26.3	4472	0.013	2	6
14.4	3765	0.034	2	6
73.4	2240	0.020	2	6
74.4	320	0.0029	4	12

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Savings on Account of Increase in Speed of Goods Trains

T. C. Sarkar* S. Chatterjee**

An increase in the speeds of goods trains leads to i) increase in sectional capacity, ii) less detention to trains, iii) quicker clearance from yards, and (v) less overtime paid to staff. It also contributes to greater utilisation of the equipments and leads to more economic operation. An attempt has been made in this paper to assess the extent of direct monetary gain on account of an increase in the average speed of goods trains. An increase in the average speed of train results in saving in train engine hours, which in turn, results in saving of locomotives and wagons. The saving in train engine hours may be calculated in the following manner:

The existing average speed may be taken as S_1 and the increased average speed as S_2. If an increase in average speed of 1 kmph is considered, than $S_2 - S_1 = 1$. Supposing that the annual total train-kilometer (T) remains the same with the increased speed also, the saving in train engine hours will be:

$$\frac{T}{S_1} - \frac{T}{S_2} \text{ or } \frac{T}{S_1 (S_1 + 1)}$$

The effect of increase in speed has been considered for a railway having electric, diesel and steam traction. The results are summarised below:

Traction	*Existing average speed of goods trains (Kmph)*	*Total Train Km.*	*Saving in train Engine hours p. a. due to increased in average speed by 1 kmph.*
Electric	25.7	54,61,000	7,958.4 Hours
Diesel	24.0	1,09,25,000	18,208.3 ,,
Steam	10.6	91,83,000	81,294.2 ,,

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Note : Statistical statements have been taken from 'Supplement' to the Report by the Railway Board on Indian Railways for 1970-71.

The saving of locomotives is found out from the train engine hours saved per day divided by the average engine hours per engine day in use. The results are summarised below:

Traction	*Train engine hours saved per day*	*Average engine hours per engine day in use*	*Number of locos rendered surplus*
Electric	21.8	19.2	1.1 or 1
Diesel	52.6	18.9	2.7 or 2
Steam	222.7	12.0	18.5 or 18

The above statement gives the number of locos becoming surplus; to this we have to add 18.93 percent for repairs. So the net savings will be as follows:

Electric — 1.3 locos or 1 loco Diesel — 3.2 locos or 3 locos
Steam — 22 locos

SAVINGS ON LOCOMOTIVES

(*a*) *Electric traction:*

		(in Rs. 000)
Capital cost of one WAG4 loco	—	Rs. 1900.0
Saving in Interest @ 6% p. a.	—	Rs. 114.9
Saving in cost of maintenance per year	—	Rs. 57.0
Depreciation on the sinking fund basis taking 35 years as life and 6% as rate of interest	—	Rs. 15.0
	Total	Rs. 186.0

(*b*) *Diesel traction:*

Saving in capital cost of 3 locos @ Rs. 2550 thousand Rs. 7650.0

Saving in interest @ 6% on capital saved	— Rs.	459.0
Saving in cost of maintenance @ Rs. 71,000 per loco per year, taking 1,10,000 km. as utilisation per year.	— Rs.	213.0
Depreciation on sinking fund basis taking 30 years as life and 6% as rate of interest.	— Rs.	87.0
Total	Rs.	759.0

(c) *Steam traction*:

Saving in capital cost of 22 locos @ Rs. 630 thousand	Rs.	13860.0
Saving in interest @ 6% on capital saved.	Rs.	832.0
Saving in cost of maintenance @ Rs. 48,000 per loco per year taking 35,770 km as utilisation per year	— Rs	1056.0
Depreciation on sinking fund basis taking interest @ Rs. 6% assuming life of a loco as 40 years.	— Rs.	81.0
Total	— Rs.	1969.0
Total savings per year on locomotives saved.	Rs.	2914.0 **(A)**

The saving of wagons is obtaind from the train engine hours saved per day multiplied by the average load of goods train which gives the wagon hours saved; this devided by 24 gives the number of wagons saved. The number of wagons (in 4-wheelers) rendered surplus under each traction is given below:

Traction	*Train engine hours saved per day*	*Average load of goods trains in 4-wheelers*	*Wagons Hours saved per day*	*No. of wagons rendered surplus*
Electric	21.8	69	1,504.2	62.6
Diesel	52.6	68	3,576.8	149.0
Steam	222.7	45	10,021.5	417.5
Total				629

Saving on wagons : Thus we find that an increase in average speed of goods trains by 1 kmph under different systems of traction will render 629 wagons surplus:

	(in Rs. 000)
Cost of a 4-wheeler wagon	16.0
Therefore, saving in capital cost	10064.0
Saving in interest on capital saved @6%	679.3
Cost of maintenance and repair per wagon per year	0.5
Total saving in cost of maintenance and repair	333.1

Saving in cost of depreciation, taking 40 years as the life of rolling stock:

The cost of depreciation is Rs. 0.0065 per rupee on the residual value; so the total saving on this account works out to Rs. 58,874.

	(in Rs. 000)
Total saving per year due to wagons saved	1071 **(B)**
Grand Total (A+B)	3985

Conclusion

The increase in the average speed of trains by 1 kmph for goods trains hauled by electric, diesel and steam locomotives represents an increase of 3.8, 4.1 and 7.04 percent respectively on one zonal railway.

The average speed of goods trains can be increased if the delays on the runs are minimised. A study of diesel hauled goods on a busy zone indicated that nearly 26% of the total train time was lost in detentions short of terminal yards/stations. An analysis on a busy electrified section of another zonal railway revealed that nearly 21 percent of the time was lost due to hold-ups short of terminals. It is expected

that provision of additional reception facilities in marshalling yards and improvements in the working will make it possible to reduce such detentions to a large extent.

With these improvements, it should be possible for the railway administration to effect an increase of 1 kmph or more in the average speeds of goods trains. The efforts and investments made in this direction will be greatly rewarding and would be a significant contribution to the national economy. □

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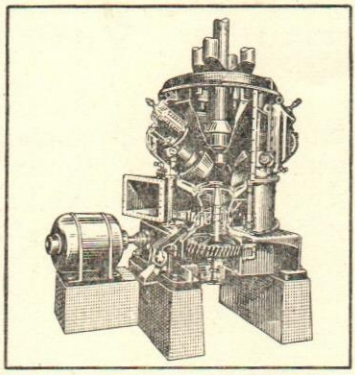

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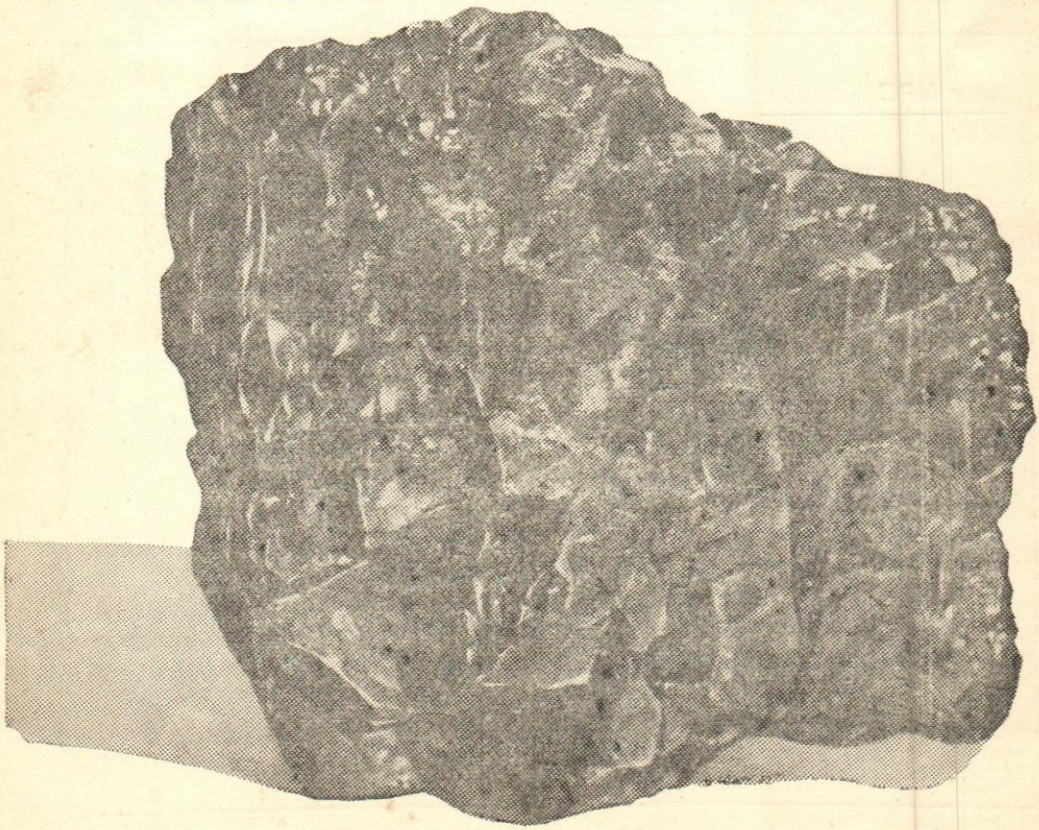

SAA/BHEL/2433

Indebtedness Amongst Textile Workers : A Case

Presented here is the summary of the findings of the survey conducted by the Textile Labour Association, Ahmedabad, on Indebtedness of Textile Workers at Saraspur Mills Limited, Ahmedabad. The survey attempts to measure the extent of indebtedness of the workers, which may in the long run provide a very useful material for both the academicians and the decision makers.

—Editor

Out of the total of 2275 workers in the Saraspur Mills, 1000 workers were selected randomly and proportionately from all the departments of the mill – which constitutes 43.9 percent of the total workers of the mill. Besides their income, expenditure, savings, facilities for obtaining loans from Cooperative Credit Society, the inquiry included information about their children, their education, women's activities as also their relationship with their native place. About, 91 percent of the workers of the said mills have been found to have incurred debts. The ratio of indebtedness ranges from Rs. 1000 to Rs. 5000 in respect of 74 percent of the workers and their average indebtedness comes to Rs. 3450.

Findings

(1) Out of the labour populace coming to work in the mills, 97.4 percent are found to be residing in the chawls of housing societies nearby; while only 2.6 percent residing away avail of Bus or Rail Transport so as to reach the place of work.

(2) The average age of 60 percent of the workers is 37.5 years. This amply portrays that the contribution yeilded by younger generation is highly remarkable in the production of wealth of the nation at large.

(3) About 35 percent of the labour is illiterate. The fact that only 40 percent have received primary or secondary education reveals that the extent of literacy among the coming generation will be on the increase in future too.

(4) The mill has 81 per cent permanent workers on the Rolls and remaining are *badli* workers.

(5) Of the total, 92 percent are married, 3 per cent are unmarried, while 2 percent are widows and 3 percent are widowers. 37 percent reside in joint families while 63 percent live separately. Obviously, most of the workers would prefer to be separated from their joint families if residential accommodation on low rental basis could be made available to them at least for the sake of each others' convenience.

(6) It is but natural that young labour have young life partners;

Age Group between 20 to 30 years— 47 percent.

Age Group between 31 to 40 years— 37 percent

Age Group between 41 to 60 years— Rest

The extent of education among these women is, however, most disappointing as 66 per cent of their wives are illiterate, while 27 percent and 5 percent of them have respectively received primary and secondary education. This implies that there is an immediate need for an elaborate programme for women's education.

(7) It is remarkable that in spite of illeteracy, men and women are found to be partners in their earnings either in mills or factories or by other means. It has further been found that 28 percent of the females are selfemployed and 58 percent of them work in mills ane/or some other avocation.

(8) It is observed that 48 percent of the women workers are earning to the extent of Rs. 100, 20 percent of them to the extent of Rs. 200 and the rest to the tune of Rs. 350 for practically supplementing their earnings towards meeting their household expenses.

(9) Ratio of sons and daughters among the labour was found to be 56 and 44 percent respectively. 45 percent are adolscents and fit to take up jobs. So far as their education is concerned, it was evident that care is taken mostly for the male-issue. Therefore, it is essential that labour organisations, government as well as other institutions give the necessary impetus to education among these boys and girls.

(10) On the vocational side, it has been found that 43 percent work as badlis in the mills, 10 percent are employed in some factories while 13 per cent of them have taken up miscellaneous jobs. The remaining 24 percent, have had employment either in Railways, Police, Sales-tax, Cooperative Banks, P.W.D. Housing Board, Income-tax, Telephones, Post & Telegraph, Municipality, E.S.I.C., or in Ahmedabad Municipal Transport Service. Thus they are adding to their income to the tune of Rs. 167.

(11) The following are the average incomes of the workers in various departments :

Spinning Department.....	Worker's average income			Rs. 426
Weaving Department.....	,,	,,	,,	Rs. 507
Warping, Sizing, Sarni Dept.	,,	,,	,,	Rs. 480
Engineering, Mechanics	,,	,,	,,	Rs. 434
Cloth Department.	,,	,,	,,	Rs. 408

Wage Groups are comprised as under :

PERMANENT WORKERS		BADLI WORKERS	
Wage Group	*Percentage*	*Wage Group*	*Percentage*
Below Rs. 500	74	Below Rs. 200	30
Rs. 501 to Rs. 700	25	Below Rs. 300	35
		Below Rs. 350	35

Those who work elsewhere besides their regular working hours in the mills belong to a limited number fetching limited extra income.

While scrutinising the items of exdenditure in relation to the incomes, very aptly the indebtedness seems to be taking its birth, in most of the cases. Expenditure is found to be ranging between Rs. 400 and 600 in case of 85 percent workers while it is ranging between Rs. 600 and Rs. 800 in case of 12 percent only. This could be classified as under :

72 percent of total income is spent after food & drinks; 9 percent towards clothing and foot-wear; 7 percent towards house rent; 4 percent towards transport; and 2 percent for their pleasure trips.

(12) Addiction to Tobacco is analysed as under : 14 percent of the workers are addicted to snuff, 29 percent of the workers are addicted to pan; 56 percent of the workers are addicted to Cigarettes; 4 percent of the workers are addicted to Drinks. This amounts to an average expense of Rs. 1.30 per day after such addictions. Cost of the tobacco, snuff comes to about 20 paisa, for pan it comes to 60 paisa, for bidi and cigarettes Re. 1 and Rs. 2 respectively, while most of the workers are found to be spending annually upto Rs. 200 in entertaining their guests and arranging some dinner parties. Some of them are also addicted to speculations after which they incur an expense ranging from 5 paisa to one rupee per day. Number of workers void of any addiction is much less. Some concrete steps need be taken to minimise the ratio of expenses being incurred after such of these addictions.

(13) Items of expenses causing indebtedness are found to be comprised as under :

Social expenses	... 42 percent.
Household expenses	... 33 percent.
Sickness expenses	... 24 percent.

If has also been traced out that 91 percent of the workers are debtors, and the average amount of debt comes to Rs. 3450.

(14) Ratio of debts incurred for productive and non-productive items comes to 18 and 103 percent respectively.

Sources of incurring debts and under :

Through Cooperatives	.. 65 percent
„ Provident Fund	... 3 percent
„ Majoor Sahakari Bank	... 5 percent
„ Shroffs and by way of mortgaging ornaments and lands and buildings.	...33 percent

It has also been estimated that 17 percent of the workers themselves are money-lenders, while kith and kin comes to about Rs. 50. It is obviously less risky to secure loans from Credit Cooperatives. Provident Fund and Majoor Sahakari Bank while other sources of incurring debts are mostly hazardous.

Ratio of rates of interest ranges as under, as disclosed by workers; 76 percent of the indebtedness charged @ 12 percent, while for the remaining 60 percent to 7 percent of interest is being charged.

It is found that 54 percent of the workers find it difficult in securing loans despite their offer of lucrative rates of interests. Possibly 1.5 per cent of the workers could have avoided incurring debts.

This amply proves that a wide propaganda need be under taken so as to minimise the extent of indebtedness among the labour by means of curtailing social expenses, putting the ESI Schemes on some sound and efficient basis and lastly, resorting to obtaining loans through co-operatives.

(15) A very outstanding item of expenditure resulting into heavy indebtedness is the social and ceremonial expenses.

Six percent of them favour to go in for savings, while a very few of them are inclined to leave their addictions, to undertake some part-time work in spare hours or even to get themselves insured.

This survey has been designed so as to diagnose the malady so deeply rampant among the working class, and the various suggestions set out are thought-provoking. □

Book Reviews

Working Capital Management

V. E. Ramamoorthy

Institute for Financial Management and Research, Madras, 1976. Price Rs. 50.00.

Reviewed by P. Chattopadhyay*

Indian books on the subject have been rather few and far between. While specific aspects of working capital have been dealt with earlier and in detail, a complete picture is hard to come by. This book by Ramamoorthy has presented a fairly clear picture with efficient handling of the crucial issues in working capital management, filling a good part of the prevailing gap. This is despite the fact that the author has not attempted a sustained empirical analysis. He has drawn a fairly wide canvas, on which each individual chapter such as the dynamic flows and the financial dilemma, planning working capital, forecasting working capital requirements, funds statements, cash management, inventory management, management of trade credit, working capital finance and delineation of frontiers of working capital management, figure as contour lines. Ramamoorthy is a cost accountant. He has grappled with day-to-day problems of industry and has also organised management training programmes on the subject thus marrying two sides of the problem to present a composite whole. He does not claim to have broken any new ground nor does he load his discussion with high sounding jargons. He goes about his job in a professional manner.

In presenting his analysis in different chapters, he has taken account of some of the most recent studies by both official and non-official bodies. Mention may be made here of the recommendations of the Tandon Group which, in his view, has said mostly elementary things regarding working capital management, creating in the process a good deal of controversy in different circles. Professor S. L. N. Simha in his foreword has emphasised that the main service which the Tandon Group has done is to highlight the importance of working capital management and to warn commercial and development banks that in their lending operations they must develop a capacity to assess the working capital requirements of the loanee units, giving them no more and no less than what they require,

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on the basis of the general credit situation and after ensuring that industrial units raise the maximum amount outside the banking system, in particular through retained earnings and issues of share capital. Both of these, incidentally, have remained at a low ebb in this country for different reasons.

Ramamoorthy underlines the importance of working capital and the various ways in which working capital is understood and interpreted. Appropriately he likens an enterprise to a living organism in which the flow of funds or the flow of enterprise values is appropriately termed as the life blood of the organism. Usual explanatory detail has been provided with demonstration of the flow effect to keep the enterprise in a living condition, emphasising in this context the importance of keeping liquidity in balance and in sensitive response to requirements. Data culled from the Reserve Bank of India studies in company finances have been presented highlighting the inter-industry differences in the status of liquidity.

Dealing with working capital planning, the author underscores factors influencing the total investment in working capital in an enterprise such as nature of business, manufacturing cycle, credit terms offered to customers, vagaries in supply of materials, demand conditions, production policies, competition, growth and expansion programmes, profit levels, taxation, dividends and retention policies, depreciation policy, price level changes and operating efficiency. While these factors generally hold good in all cases, we in this country have found each of them assuming the position of a key factor over time.

The author illustrates different facets of assessment of working capital requirements with industrywise information on the length of operational cycles in selected Indian industry groups. Usual methods of forecasting and assumptions behind them are analysed in some detail. He provides supporting data and examples of different methods of analysis in this context. In his view, the operational cycle for the product or family of products can be traced through four sequential stages, namely, raw materials inventory, work in progress, finished goods inventory and book debts and expressed in number of days. Enterprises have faltered widely as regards properly assessing their financial needs, in particular working capital needs, and have had to bear the brunt of unplanned expansion, catching them unawares most of the time. His treatment of

requirements is factual and incisive though not complete.

Management of cash is one of the vexatious problems confronting industry and business irrespective of scale of operations. Proper cash management implies walking on the tight rope and maintaining a delicate balance between overtrading and undertrading and overcapitalisation. Idle cash is an unprofitable asset, whereas lack of adequate cash can turn the flourish in the market place into red without prior notice. Paucity of short term funds from different external sources including banks has made cash management extremely tricky. The author has substantiated his contentions with case studies from different Indian companies In the public and private sectors He has given examples of different methods of analysis that may be purposively used for efficient cash management. He underlines five essential steps in inventory management, namely, classification and codification of items of inventory, ABC analysis, setting stock levels, perpetual inventory and evaluation through selected inventory ratios. In this context usual inventory control practices have been discussed with illustrations.

Management of trade credit, on the other hand, has been dealt with in the light of the practical reality. Managers and cost and management accountants would particularly like the discussion on the cost-benefit axis detailing out the costs and benefits to indicate why in a particular situation described by him (pp. 203-204) cash discount could be allowed. This area has remained rather untrodden by researchers and analysts. At present, it is haunted by all kinds of doubts, prejudices and uncertainties. Stickness of credit has caught many a flourishing unit on the wrong foot. The accounts hardly reflect this problem adequately, especially because the calculation of profit is based on accruals, not realisability while payment of advance tax is a cash problem. This has further augmented the short term requirements of funds. Detailed inter-industry analysis is required to shed light here.

The modes of working capital financing in this country have been discussed indicating the package of practices in this country. The percentage composition of working capital finance for medium and large public limited companies in India shows telling changes over time. The efficacy of Tandon panel recommendations on credit norms has been considered in the light of the prevalent practices in Indian industry on the basis of RBI data. The author is right in mentioning that "some

the funds statement in the context of forecasting working capital may see, in industry, a veritable villain, exploiting bank credit without let on hindrance". This is proved by an analysis of relevant facts and the background conditions in which the credit squeeze has operated. However, he does not deny the rationale of the basic approach of the Tandon panel.

The author pleads for resolving the problems of working capital finace on a long-range basis by suitably readjusting the capital structure. He wraps up the discussion with an indication of different methods, of analysis of working capital management and the role that linear programming, value analysis, standardisation and computerised programming, may play in the near future. This last chapter hangs loose and does not present a coherent picture. It could have been avoided without detracting from the value of the book, while the inclusion of a chapter on working capital management in public sector enterprises would have enhanced its usefulness. Nonetheless, the book should be read with interest and profit by managers, professional accountants and students alike. □

Export Inspection in Asia

Asian Productivity Organization, Tokyo, Pages vi+193.

Reviewed by J. D. Verma*

The volume is indeed an informative and useful book on the Export Inspection in Asia published by the Asian Productivity Organisation. The book is based on the proceedings of a symposium on the subject held in Tokyo during June 1975. According to the country papers presented in the symposium and the observations made by the participants in the discussions, it is clear that most of the Asian countries which have ushered into industrially developing era in the recent past, fully realise the importance of maintaining the quality and standard of their products.

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Thus alone they can sustain in the international market where the importer is always expecting a high quality and standard of products imported. No doubt the price is in itself an attractive phenomenon, yet in the export, market, it cannot overshadow the international quality and standard of the exportable products.

"The truth is something you believe and not what someone tells you". This is particularly applicable in the international sale and purchase of goods where quality is a major factor . It is the actual quality and standard of the product made by the manufacturer/exporter which will determine a lasting trade relationship between him and his counterparts in the importing countries. The importance of this gathers more momentum in developing countries which, in order to ensure adequate and regular flow of foreign exchange into the country to facilitate the overall economic development, have placed great emphasis on boosting their exports to developed as well as to other developing countries. In most of the developing countries of Asia, there is a greater awareness both on the part of the Government as well as the private individuals about the necessity of having some sort of inspection/control over the quality of the products specially those which enter the export market. The book brings out that most of the developing countries in this region are gradually following the Japanese system. For example, countries like India, Hong Kong, Pakistan, Singapore, Republic of China, Phillipines, Republic of Korea and Sri Lanka have taken various steps as in Japan to exercise control over the quality and standard of the exportable products. However, as one observes from the study of the country papers presented in the Symposium, the initiative has come from the Government, though one does come across, here and there, the role of the private inspection agencies. Generally the chances of deflection are more if the implementation of a programme is wholly initiated, run and controlled by a governmental agency. It is hoped that Governments in the APO member countries will encourage private inspection houses to take advantage of the knowledge and information about the types, methods and standards of inspection as have been adopted by various countries and incorporate some of these in their own system. While doing so due regards will have to be given to the national standards of quality, the apparatus available with the manufacturers and the inspection agencies and the intensity of dependence on export for overall economic development of their respective countries.

An important issue which deserves special mention in this regard is the role of free-export inspection of products made in the small-scale and medium scale industrial units (particulary those which are engaged in the manufacture of components, parts and sub-assemblies on behalf of the principal units). Unless in-process control over the quality and, standard of these components, parts and sub-assemblies is imposed there is every likelihood that the quality of the final products, which may have an international market, will suffer. At this stage, even the existence of export inspection agencies will not be of much use to the country at large. It is, therefore, necessary that the Government and private agencies, which are charged with the responsibility of inspecting the goods entering the export market, introduce some sort of control, supervision and guidance on the smaller units through either their own designated sub-units or the extension service agencies which have been charged with the function of promoting small and medium scale agencies.

Reference in this regard is made to the Small Industries Service Institutes and extension centres in India which, through their technical officers, have done a useful service to the industrial units not only in their initial development but also in helping the units to produce goods of reasonably good quality. However, there is need for a special cadre of technicians whose major function should be to guide and help the industrial units in adhering to and maintaining the standards of quality as are acceptable in the international market. The book under review gives useful hints in this regard. In a country like India, where because of its huge size, all areas have not doveloped alike in adopting advanced technologies, there is need for a phased programme to bring about a system to inspect quality of exportable product. This can be done by organising special courses for the manufacturers from these area at a central place where, besides theoretical knowledge, the participants could be given advantage of visiting industrial units which are fairly well equipped and which have made a reputation about the quality of their products. It would help in achieving the aforesaid objectives.

The book makes a mention of voluntary inspection cells. Although it is perhaps too early for all the developing countries of the region to expect this initiative from the manufacturers, yet voluntary system does allow the manufacturer, who is expert in his own field, to make sound business decisions so as to prove successful in meeting the specific requirements of standard and quality as have been fixed for his products.

An important issue brought out in the book relates to the correlation between the national standards as adopted for internal consumption in the country and its national standards of the product as brought out by the acceptability of the buyers abroad. Now doubt, it is not necessary that the two may always be the same as besides many other factors, the difference may result from different in propensity to pay so far as the buyer within the country and abroad is concerned. However, national standards may become the base on which the international standards may be determined. While doing so, sometimes special needs of the importing countries have to be kept in view and accordingly the Government may relax or permit certain changes here and there in the national standards. Example in this regard has been given of the bicycles exported from Japan to the U.S.A. As according to the norms laid down by the Consumers Products Safety Committee of U.S.A. special device had to be provided in the bicycle so as to meet committee's requirements although national standards in Japan did not make any provision for the same. Moreover, the national standards of a country may be totally different from the one adopted for the same products in the other country. It is the consumer in the export market whose preferences of quality and standards are to be kept in view so far as the exporting manufacturer is concerned; of course this is reflected in the consumer preference studies which ultimately form the basis for making purchases of the items from different markets abroad. Adaptability in this regard of Japanese manufacturers deserves a special commendation. Of course, the Japanese exporter is fortunate in having the patronage and assistance of its guild and the national exports inspection cells both in the Government and privately designated agencies.

In India and in some other countries of the region too, private agencies have been designated to perform this function. But there is no information about adequacy or otherwise of the competence and possessiveness of the necessary mechinery and apparatus of these agencies. As such, many a time the exporters fall a prey to the whims of the actual inspecting officers. It is, in this context that special emphasis has been placed on the integrity and honesty of the export inspecting official who are to perform this important function. It has been rightly recommended in the book that these officers should be responsible persons and they should be paid more than normal wage so that they do not fall a prey to the underhand tactics of trader at the cost of quality and ultimately the market abroad.

It appears that perhaps because of over ambitious policy very soon a large list of commodity has been drawn which are subject to export inspection. It is not clear if the inspection agencies irrespective of the government or privately controlled are fully equipped to exercise such export inspection control. There is a possibility of delay in inspection and actual despatch of the product for the destination if the aforesaid assumption is correct. It is hoped that all these issues are being taken care of by the various member countries of the Asian Productivity Organisation which have very rightly introduced export inspection system in their respective countries.

The book will prove extremely informative and useful to the planners, administrators and Government and non-Government agencies which aim at introducing pre-export inspection system for almost all commodities entering the field of exports.

Productivity, Wages and Industrial Relations

G. K. Suri

East-West Press, 1976, pp ix+144, price Rs. 38.00

Reviewed by V. S. Mahajan*

Labour is a vital partner in industrial development. While machines could be imported and factory buildings constructed without much difficulty, the real rub lies in the utilisation of equipment for gaining maximum output per unit of input. This (i.e. growing productivity) would as well cut down cost per unit output and thus help marketing of products at competitive prices. Besides, alert and devoted labour force would try to produce goods of quality which would find ready market (especially in foreign countries where quality plays a dominant role). Much would, therefore, depend on the performance of labour (perhaps the most important input in Industrial production), how well it is trained

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and disciplined, how far it receives wages adequately linked with performance as well as cost of living and how healthy are the industrial relations. All these factors are important for boosting industrial production.

The book under review which is a collection of papers published by by the author in mostly *Indian Journal of Industrial Relations* during the last few years, devotes itself to the above issues. The first paper "Productivity Bargaining" tries to examine the concept of productivity bargain ing in relation to a large public sector light metal plant in Kerala (the identity of plant is not disclosed) The author says that this is the only plant which approximates to the productivity bargaining concept According to him the essential features of productivity bargaining are :

(1) Productivity bargaining is a part of total concept of the firm. It involves the whole management team and is a part of the process of deploying human resources optimally; (2) Management assumes an active role in identifying the areas of cost reduction and productivity improvement, and plan for the achievements of the targeted improvements. This planning demands intensive management communication with unions, workers and various levels of management; (3) productivity bargaining is used for eliminating restrictive and unproductive practices. Economic concessions are related to the savings in cost. The proffer of economic concession motivates the acceptance of the changes conceived, (pp. 1-2).

Applying thess features it was found that there were lapses in the plant under study. "Labour-management relations in the plant were perceived to be comparatively peaceful and normal by the executives and the non-executives.. However 53.1 per cent of the union functionaries perceived the relations to be strained. The reasons given for this were mainly related to the disparity in policies and earnings and the management's delay in taking decisions Corrective measures could be taken by the management," (p-11). The management was found to be not playing an active role in union-management relations. Also it was found that communication with labour was the weakest area of management. The author adds: "The most important man for the implementation of a productivity agreement is the first-line executive. It is his responsibility to allocate jobs, schedule overtimes, handle shop-floor problems in the first instance, and exercise the first level control on production. This

makes heavy demands on him. Therefore, he has to be thoroughly trained and his problems should be given high priority," (pp. 13-14). This is unfortunately lacking in Indian industries and more so in the public sector.

The next paper "Inflation, Unions and Workers" tries to examine the impact of recent (rather prior to mid-1975 period) rapid rise in prices on the attitudes of unions towards this and "what they have done to assist workers in containing the impact of inflation on the latter and how this phenomenon has affected their attitudes and activities," (p. 16) This study is based upon interviews with functionaries of trade unions in an industrial complex in Delhi (Karampura). It was found that heterogeneous pattern of payment of D. A. prevailed and that adjustable D. A. to compensate in the rise in price existed only in large units and not in small and medium units where fixed wages were paid without any component of D. A. Even in some large units fixed wages were paid and where wages were readjusted to the cost of living it was found that neutralistion was partial and also that payment of D. A. was so delayed that prices rose further in the mean while necessitating further pressure from the unions.

"Wage-payment System" are discussed next. Here the author analyses three principal types of wage-payment systems (i.e. time wage, piece-wage and wage-incentive). Under the individual or group incentive system, the author makes a detailed study of Halsey, Rowan and Bedaux plans separately. Also are discussed Scanlon, Rucker and Kaiser Plans in context with plant-wide incentive system.

Next he goes over to "Impact of a Wage-Incentive Scheme on Productivity" which is based on the investigation of single engineering factory in the public sector. The author says "that in the majority of the jobs investigated, the wage-incentive scheme succeeded in raising productivity, increasing workers, earnings, and reducing direct labour cost. The results confirm the general belief that wage incentives can raise the average level efficiency of workers. (p. 42).

"Collective Bargaining and Time Standard in a Wage-Incentive Scheme" is the subject-matter for discussion in paper 5. Here the author attempts to analyse and examine in the Indian context issues of time standards in collective bargaining. According to him, the wage-incentive scheme being

a managerial device for obtaining higher productivity from workers by motivating them to increase physical effort may be said to pose these characteristics:

"(i) determination of standards of performance for each job and task with the help of time study or some other method.

(ii) predetermination of a formula which relates actual performance to the standard of performance for computing incentive earnings," (p. 55).

It is stated that perhaps the USA is the only country where incentive clause figures prominently in the collective bargaining agreements. It is no surprise to find that in India collective bargaining has yet to take roots and wherever collective bargaining agreements have been entered into in this country it has been found that these are incomplete in one respect or the other (for example the contract provision on time standards are generally lacking).

In paper 6 the relevance of "The Lincoln Incentive Scheme" to Indian industry is discussed. The key elements of Lincoln Electric Company (Cleveland), USA, have been summarised as follows :

"(1) To produce more and more of a progressive better product at a lower and lower price for a larger and larger group of customers.

(2) To reward workers in direct proportion to their contribution towards the Company's success through better methods, designs and skills.

(3) To establish the identity of workers, interest with organisational goals and to inculcate in workers a spirit of cooperation, involvement, and belonging," (p. 63).

The author states that the implementation of the above principles was sought through a multi-dimensional system evolved gradually since 1934. Subsequently he deals in detail with such multi-dimensional system. One would agree with him that the existing Indian conditions are perhaps not favourable for the introduction of such an incentive scheme.

The inter-relationship between money wages, real wages, unit cost

and productivity is discussed in the next paper "Wage-Cost-Productivity Nexus and Income Policy". Using data of Annual Survey of Industries (ASI) 1960-66, Indian Labour Statistics and RBI Buttetin (for wholesale prices of manufacturing industries), the author finds that there is a significant correlation between total money earnings and cost of living. There is however no significant correlation between real wages and cost of living, and between real wages and productivity. He further finds that the average ratio of wages cost to unit production cost varies from maximum of 4.7 percent in the petroleum refinery (capital intensive industry) to 2.3 percent in the case of cotton textiles (labour intensive industry) and for the aggregate of industries it is 13.1 percent; that real earnings in industries studied have almost been stagnant over these years with 1960 as the base period; that productivity (output per man hour) has gone up on an average by 12.3 percent for the aggregate of industries; that non-wage benefits from a mere 8.8 percent of total money earnings; and that the share of workers money earnings in the value added in respect of aggregate of industries indicates a decline in average.

The author discusses the possibility and nature of income policy in a developing economy characterised by low wages and mass poverty in paper on "Determinants of Workers Money Earnings and Income Policy". He concludes that "an improvement in the standards of living of Industrial workers without an adverse effect on the volume of employment is possible only if (a) the growth in productivity in real terms is accelerated significantly, and (b) prices of consumer goods and industrial products are stabilised," (p 90.) Participation of workers in management with special reference to Scanlon Plan is discussed in paper 9. According to the author" the Scanlon Plan provides a participative framework, and through it the means and opportunities for employees to satisfy their monetary and higher-level needs and contribute through their efforts to the economic welfare of an organization," (p. 97). While labour reaction to thechnology innovation is discussed in the next paper "Technological innovation as a Factor in Industrial Reaction," the relation of white collared employees to office automation (mainly the introduction of computer) is discussed in the following paper (11) "Man-power priorities in Indian industries would promote their healthy growth. The author lists the following as major man-power practices related to organisational effectiveness and productivlty : (a) recruitment and selection, (b)training

and development, (c) performance appraisal and promotion (d) wage and salary administration, and (e) manpower planning," (p 129). He subsequently elaborates these practices makes a special mention of manpower problem in public sector.

Thus each paper included in the book as would be evident from the review, makes a scholary attempt on the varios facets of worker-management relations. Through theoretical approach as well as case study methods, the author makes an objective study of the present worker-management relation and offers suggestion for the improvment of these relations for obtaining better results. It is through the active participation and cooperation of workers and the emergence of enlightened management that industrial growth would reach new dimensions. The book should be read with interest by all those interested In India's development and by labour economists in particular. It also tries to spell out a number of policy issues which should be examined with care by the Government. □

Loans to Small Industries and Small Borrowers

Sudershan Lal

Navrang Publishers, New Delhi, 1976, pp. 222. Price Rs. 20.00

Reviewed by N. L. Dhameja*

The book intends to fill the vacuum on information relating to financing of small scale industries, and to provide information to the intending borrowers regarding type,of credit facilities available, formalities to be performed and the discipline to be observed.

First three chapters describe various types of advances and the credit facilities available to small scale industries and technocrats. Fourth chapter gives the idea of the project and the format in which project

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should be presented to the credit institutions for various types of financial assistance—long term and/or working capital loans. The loan facilities available from various agencies are compared in chapter five to show the most suitable agency considering the amount of the loan required, cost of the loan, and the time involved in getting the loan.

Chapter six gives a fair idea about the credit facilities to small borrowers—self employed, agriculturists, artist and persons belonging to low income groups. The credit policy and guidelines issued by monetary authorities regarding the credit assistance to above small borrowers are discussed in chapter seven.

The valuable information regarding how to approach financial institutions and also regarding various schemes of assistance to small borrowers are presented in the chapter eight and various appendices at the end of the book. The particulars of agencies providing technical, economic and consultancy services to entrepreneurs are given in the last chapter.

Lastly, the norms regarding inventory and working capital as laid down by the Tandon Study Groups are stated to illustrate that the part of the working capital needs are to be met out of the owners' funds or out of long term funds.

In short, the study presents information regarding assistance to small industries and small borrowers but presentation of the information could have been better to be more meaningful and the repetitions could have been avoided. □

Education and Employment in India –The Policy Nexus

Trilok N. Dhar, Alice Stone Ilchman and Warren F. Ilchman

Minerva Associates, Calcutta, pp. 137+100 Statistical tables; Price : Rs. 40.00

Reviewed by Om Narain*

It has often been said that the Indian education system suffers from certain inherent defects, and most of the planners, educationists, scholars and men of letters contend that the system must be employment-oriented. A young graduate who perhaps entertains high hopes of his future gets disllusioned within a short time when he has to knock from door to door for work. Of course, the situation is fast improving, and our administrators and thinkers have been endeavouring to mould the pattern of education.

"Education and Employment in India" is a study in depth of the vital problem of the relationship between education and employment. Written by three eminent educationists, the book is the result of a survey exploring the educational and occupational expectations of college students.

In the Preface and Acknowledgements, the authors say that the "survey formed part of a comprehensive inter-disciplinary research project on the political economy of educated unemployment in India assisted by the Professional Schools' Programme of the University of California, Berkeley.

A detailed questionnaire was prepared and circulated among 1,200 college students drawn at random from nine faculties and five university campuses of the five regions of India.

The book poses many vexing issues that confront the country. The population explosion, the escalating percentage of literacy including the ever-increasing number of degree-holders, without corresponding opportunities for work and employment have been causing grave concern to the authorities. The research study brought the three scholars to

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the conclusion that capital-labour ratios and the projections of demand may satisfy planners, but "development" may never provide in India the abundance of employment opportunities necessary to keep pace with the number of young people seeking work. "This is a key problem for the next several decades for anyone concerned with the use of human resources in India".

The book has made a comparison of the situation existing in advanced countries like the United States and England and observes that an excess of supply of educated persons over the demand for their services has been a short-term problem every-where in the world at some time or another.

Different countries have varying socio-economic structures, political systems also differ. But in a country like India, the majority of educated boys and girls seem to have a common goal—earning bread for themselves and their families.

The facilities selected for the comprehensive survey include Arts, Science, Commerce, Engineering, Medicine, Law, Education, Agriculture Management and Miscellaneous. St. Stephen's College, Delhi in Arts and Kanpur in Engineering have been treated as special categories. For instance, it has been shown that 61.9 percent students from St. Stephen's were 19 years of age and below, as against 1.6 percent in Agriculture.

The chapter on the Policy Nexus is the most significant in the entire research study. In the field of higher education—India is experiencing a state of hyper-educational inflation—a degree is considered money convertible into a job. Some people are of the view that the standard of university education has considerably declined and the present-day graduates could be compared with those of intermediates or at times with matriculates of yester years. Of course, there is no denying the fact that with the advancement in the technological and scientific knowledge, boys and girls with greater skills are required in various services. The problem of Nexus as far as Education and Employment in India are concerned is far too complicated to warrant any satisfactory solution, especially in a fast developing economy. Difficulties will always arise at one stage or another.

The authors have discussed almost all possible aspects of the situation not only as it exists today but also as it is likely to grow in the years to come.

The most remarkable feature of the treatise is a huge list of tables explaining the salient points discussed in the main text. This method of study is considered modern and more thorough as things not clarified otherwise are easy to comprehend through charts and tables.

We have come across many books containing tables and charts, but hardly any with exactly one hundred in a book which has just about 130 pages of the text. Reference books made use of by the authors add up to more than 50.

"Education and Employment in India" is a book of immense utility to those interested in finding solutions to the complicated issue of work and study. □

Watch Your Figures

C. Northcote Parkinson, M. K. Rustomji

Macmillan Co. of India Ltd., New Delhi, 1976, Rs. 12.50

Reviewed by Ram Prakash*

'Watch Your Figures' : is an interesting reading for all those having interest in cutting costs and making more profits. The attractive eve figures on the book cover may be misleading for those who are looking for secrets of body form make up. This misconception is corrected as soon as one turns inside pages. The superlative degree claim of the book "most humorous' 'illustrations and of being "most constructive" may have publicity value. It certainly does not indicate the merits of the book written by famous authors C.Northcote Parkinson and M. K. Rustomji. Parkinson is well known for his several best sellers and some of his

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ideas have assumed universal acceptability in the form of well tried laws. Rustomji carries with him rich experience of industry as financial controller and is an author of quick sold book 'Watch Your Costs.' The book has been published in India and is priced in indian currency, but is illustrative of mostly American business scene. It has macrocosmic approach and refers to all sorts of problems of labour idle time, waste reduction, inventory control, hidden costs of delays, frustrations, breakdown, etc. and attempts to illustrate the theme with attractive sketches. Quite often one feels that sketches do not have a bearing on the theme. It indeed indicates effective mode of worship of idol of profitability which is the pursuit of ever increasing business aspirations. The book could have been more interesting if theme would have greatly relied on success or failure stories rather than generalities. On this account one might feel it to be of simplistic with a sort of nursery quality in narration. □

Accounting For Management

Text and Cases

S.K. Bhattacharya and John Dearden

Vikas Publishing House Pvt. Ltd. (India) (1976) Pages 556, Price Rs. 24.00

Reviewed by N. Varadan*

The imprint of the Harvard University is manifest throughout the book. Presumably the first part has been written by the Professor from I.I.M. Ahmedabad and the second part by the American counterpart, as evidenced by 'Rupees' and 'Dollars' appearing respectively in the said Parts. The case study method has been chosen as the medium of communication, since, as the authors observe in their 'Preface,' the 'new Math' of Accounting demands it. The American method of carrying the readers along, is evident from the handling of the Problem on 'Ratio Anlysis' based upon the Indian Aluminium Company Limited. But it is distressing to find that certain portions of the published accounts of the

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