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Dynamics of Organisation Structure at Work: A Review of Theory and Some Indian Evidence*

S. A. ANWAR
Lecturer, Faculty of Management Studies, University of Delhi,

The objective of this paper is to review theory and some Indian evidence relating to the dynamics of organisation structure at work. The study presents qualifled answers to some interesting questions that find place owing to gaps in knowledge focussing on the relationship between organisation structure and the dynamic behaviour of its members with special reference to the Indian context.

Organisation structure has come to be accepted as an indispensable means for attaining business objectives effectively. A structure of roles must be designed and maintained for organisational members to work together in carrying out plans and accomplishing objectives. The process of structuring the organisation normally involves the grouping of tasks necessary to accomplish plans, the assignment of activities to departments and their members, and the provision of coordination and control through clear delegation of authority.

What type of organisation structure should be introduced and maintained in a business organisation to attain the avowed objective of effectiveness is a challenging question for managers in India. In fact, a broad spectrum of organisational arrangements are in use in the Indian organisations aiming to improve the performance and satisfaction of organisational participants. The history of these arrangements demonstrates a transition from the earlier static formulations of pioneer theoreticians and practitioners in the area of organisation theory to a contemporary realisation that organisation includes within its orbit a dynamic system that has sweeping implications for organisational behaviour. In this paper an attempt is made to (a) review briefiy the trends in theory and practice relating to organisation structure with special reference to the Indian business

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organisations, and (b) examine the dynamics of these trends with a view to focussing sharply on the issues and problems of organisation structure and behaviour.

The paper attempts to study the organisational characteristics of some Indian business organisation—both public as well as private. A review of the existing trends relating to formal organisation structure in India reveals the following main characteristics :—

1. Task specialisation

A concentrated effort on a limited number of endeavours is effected to improve organisational and managerial efficiency. However, our Interaction with some Indian organisations suggests that this kind of specialisation has reached an all-time high, sometimes to the detriment of the organisational participants who are all well trained in one narrow field or task and suddenly find that such jobs no longer exist owing to changes in the environment.

2. Unity of direction

The unity of direction notion states that organisational efficiency increases when every person in a unit has a single activity or homogeneous set of activities under the direction of one supervisor. This state of affairs seems to have been appreciated, at least in principle, in scores of Indian organisations in view of its intuitive appeal. However, instances are available that contradict this principle of formal organisation. A study of a very large multi-unit, multi-product private sector organisation revealed that in a section, the staff members would receive command relating to responsibilities from section officer as well as the departmental manager owing to the over-ambitious role of the manager. In the same organisation it was found that the managing director without caring for hierarchical considerations would assign responsibilities to individuals at supervisory levels in addition to the responsibilities assigned to them by their departmental managers because these persons happened to be the "apple polishers".

3. Span of control

This characteristic of formal organisation points out that efficiency is increased by limiting the control of a leader. In other words, the narrower the management responsibilities, either in diversity of tasks or the number of people to be managed, the greater the possibility of efficiency. The application of this control principle in some Indian organisations accounts for what sometimes appears to the outsider to be a top-heavy organisational structure. In a large private sector organisation, we found that the span of control was very large at the level of senior general manager who had about a hundred people reporting directly to him. Interestingly, another three hundred people not reporting to the senior general manager were also controlled by him indirectly in view of the fact that decisions pertaining to their placements, promotions, appraisals and salary structures were all taken by him.

Hierarchy of authority and responsibility

The actual formal organisation is created by forming the individual tasks into an interdependent and related pattern. The assumption is made that managerial and organisational efficiency is increased by arranging the individuals in a hierarchy of authority and responsibility with the individual on top commanding and controlling the individual on the bottom.

Such hierarchical patterns are commonly found in India. We studied the actual relationship of responsibility with authority with the help of some public and private organisations in India. Generaly it was found that responsibility increased and the authority decreased from the higher to the lower levels of hierarchy. In an interesting case, it was found that a departmental manager who was responsible for the output and efficiency of the people in his department did not have any authority to grant special increments, promotions or even to effect transfers of section incharges, section officers and staff members from one section to another in the same department. Some officers in a public sector organisation shared with the author that they had enormous responsibility to undertake without any authority even relating to routine matters which had negative implications for organisational efficiency.

An approximate analogy would be to conceive of the above characteristics as a formal organisation's anatomy. They provide the structural foundation within which the organisation functions. While there is no denying the fact

that formally structured organisations have come to be used quite widely in India, they are faced with certain dilemmas. Some of the chaotic dilemmas found in a formal organisation in India relate to bureaucratic discipline, effective use of professional expertise, coordination and control, managerial planning and initiative, and communication. The implication of dilemmas such as these relates to the dynamics of organisation structure. We now turn to examine this dynamics in the following section.

The Dynamics

The research findings relating to the dynamics of organisation structure and behaviour began mainly with the findings of a classic set of studies known as the Hawthorns studies[1]. Following these studies, researchers in the area of human relations began to be concerned about such variable as morale, social relations, worker attitudes and performance. But just as the classical approach was too concerned only with structure and function, the human relations approach has often been too concerned only with people.

In order to synthesize the classical and human relations approaches to organisational analysis, the structuralist approach[2] came into being to encompass such dilemmas as strains between organisational goals and personal needs, between discipline and autonomy, and between management and workers. The structuralists see the organisation as a complex social unit with many smaller social subgroups constantly interacting. The synthesis is not necessarily complete since there are still some pure human relations advocates and even pure classicists; however, the structuralist movement has brought about a broadening of the general approach to organisation structure analysis.

In the last couple of decades a formidable body of knowledge has been built up relating to the dynamics of organisation structure.[3] The bulk of literature has tried to demonstrate that the organisation functions as an open system that makes exchanges with its environment and that it is contingent on such main factors as technological change and growth for attaining effectiveness In other words, growth and change are possible in an open system because its self-adjustive factors prevent any extended state of disbalance. Such a system reacts to change or anticipates change through growth which assimilates the change into the existing structure. A new operational level is thus established and the organinsation adjusts and functions around this new level but with the same old internal equilibrium.

The application of contemporary wisdom in the area of organisation structure and analysis has found place in India. Here it would not be out of place to cite the changes that have been effected in the structure of a leading bank in the country owing to growth factors. The bank had 466 branches at the time of its nationalisation in 1955. In 1970, it had 2300 branches all over the country. Following this growth, several changes had to be introduced in the organisation structure of the bank to maintain its competitive position in banking. Some of the more significant changes that had to be effected were: (a) several new regional offices had to be opened to service and control increasing branches, with delegated authority for making business and administrative decisions, (b) decisions on such matters as large advances had to be centralised, and (c) the management had to set up special groups to review recruitment, selection, promotion, appraisal, and training needs of the organisation.

From our study of the dynamics of Indian organisation structures, we are safely in a position to conclude that consistent relationships between structural properties of organisations and their participants' attitudes and behaviours have been established. However, the problem remains that these relationships in operating situations have not been examined and analysed adequately in research. In addition, studies aimed at understanding these phenomena have not always used the same definitions of terms and the same measurement techniques. With these constraints in mind, let us risk summary answers to some important questions relating to the dynamics of organisation structure on the basis of our experience of the Indian organisations.

Does position level relate to satisfaction ?

The answer, while based on fewer studies, would appear to be yes. As one moves up in an organisation, satisfaction increases. The job itself, recognition, achievement, and prestige are more frequently cited sources of satisfaction in

the situation when the individual is nearer the top of the organisation.

Are specific job behaviours and level in the organisation related ?

Logically, the answer would appear to be yes. But, we hardly have any evidence to support such a relationship. In fact, it is not very clear which specific behaviours are important enough in managing to focus our attention in this area of research. We can simply suggest that managers should beware of leadership theories that automatically claim a scientific basis for an association between organisational level and specific behaviours required for success. We feel this is an under researched area of study.

How about size of the organisation ?

This question is quite simplistic and rather innocent. The effects of total organisation size on participants' behaviour, if any, are likely to operate through other factors. For example, as size of the organisation increases, the requirements of coordination and control become more complex. This in turn, also means that the administrative component of the organisation expands. This may cause the general level of professional expertise within the organisation to rise, through selection and/or training. What independent effect organisation size exerts on participants' behaviours is an empirical qestion.

How about centralised structure versus decentralised structure and tall structure versus flat structure ?

These characteristics impact organisational participants' satisfaction and behaviour. For example, high-level managers in tall organisations and lower-level managers in flat organisations normally experience more satisfaction than their opposites. Our experience of the effects of decentralisation, which has been predominantly defined as participation in decision making, centres around lower-echelon managers. For these managers, evidently, job satisfaction increases as decentralisation advances.

We have not been able to do justice to the questions outlined above owing to paucity of information. In fact, we have taken a cautious tone throughout this paper. Such a posture may seem too conservative and too academic. But we strongly believe that caution is the only sensible course when the evidence at hand is as patchy and incomplete as it is. Moreover, the realities of the dynamics relating to organisation structure particularly in India are more complex and mysterious than we have assumed. It is, therefore, quite evident that the discovery of complexities and contingencies is long overdue in the area of the dynamics of organisation structure in India. We hope this paper would lead to further research focussing on the dynamics of organisation structure at work.

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The Sugar Factory and Rural Development*

Mrs. VIMALA RAGHAVACHARI
Mrs. Senior Lecturer, Miranda House, University of Delhi

Development and economic growth of India has no meaning without development of our rural areas where more than three-fourths of the country's population still lives.

While the rural industrialisation programmes of the Government of India envisaged small scale and cottage units, the establishment of a sugar factory has often contributed to the development of the area.

This paper studies the economic impact of the establishment of a sugar factory on the area and draws the conclusion that the successful sugar factory can be one of the means of rural transformation.

The establishment of a sugar factory often acts as a 'growth point' resulting in the development of the region around the factory. The term 'growth point' describes both an observed condition and an instrument of planning which is adopted with the hope that the prosperity generated by the growth point will eventually spread on into the less favoured areas.[1] In the Indian context, it may be observed that the sugar factories have helped in the transformation of the area in which they are located and in many instances small townships have developed in places of the under-developed rural points. This paper attempts to measure the extent of industrialisation achieved on account of the location of the sugar factory in the region, in terms of the change in the number of industrial workers in the location over time. A typical rural area without any modern industrial unit is not likely to have workers well versed in modern industrial processes or modern industrial discipline.

The concept of rural industrialisation is basically socio-economic and multi-sectoral process which in time encompasses all sectors of social and economic activity and provides the necessary balance between industry and agriculture and between urban and rural environs. Industrialisation is and can be a dynamic force capable of initiating rapid development in the developing countries. But as UNIDO points out, "Industrialisation on a significant scale has

* Based on a chapter section of the author's doctoral dissertation on "The State and the Indian Sugar Industry, 1956-70. Poona, University, 1974.

indeed taken place in a number of developing countries and a wide range of manufactured goods has become available from local production. However, while efforts to industrialize in some developing countries have led to encouraging results, large segments of the rural populations of these countries have benefited little if at all from the progress achieved"[2].

Again, the pattern of industrial growth has tended to favour the urban rather than the rural population with the result, the product mix is largely oriented towards urban consumption needs and a distortion of income distribution and employment opportunities. The UNIDO study points out that "the nature and pattern of industrial development needs to be re-oriented in order to fulfil the aspirations and requirements of the majority of the population of developing countries and, in particular of the poorest sections of the population. This calls for increased efforts to develop industry in rural areas on a greater scale than heretofore"[3].

In India the programme of rural industrialisation was taken up since the beginning of the second five year plan in a conscious manner. The Industrial Policy Resolution of 1956 had stated that, unless disparities in development between different regions are reduced, industrialization is not likely to benefit the economy as a whole. The policy stated "only by securing balanced and co-ordinated development of the industrial and agricultural economy in each region can the entire country attain higher standards of living"[4].

Development of industries in the rural areas provides opportunities to productively employ the unemployed and under-employed labour which can not otherwise be employed in urban centres. Employment opportunities do not grow sufficiently in the urban areas and in any case it is no solution to the seasonally free rural agricultural labour.

The Karve Committee while stressing the principle of de-centralisation of industrial development suggested the spread of small industrial units alongwith the necessary services among the big villages or small towns spread all over the country to build "a pyramid of industry broad-based on a progressive rural economy"[5].

The Planning Commission initiated the Rural Industries Projects programme in 1962-63 with the basic objectives of enlarging employment opportunities, prevent or minimise the migration to cities, raise the income level and reduce regional economic imbalances. This programme was extended in subsequent Plans but the emphasis was on small and village industries. A study points out that the scope of rural industrialisation was limited to the traditional village industries and also ruled out the possibilities of modernising them to the extent that necessitates additions to capital equipment and change in technology, reducing employment potential[6].

Large industry and rural industrialisation

Should rural industrialisation policy restrict itself to the traditional small scale and cottage industries ? Can a large industrial unit located in a rural area act as a growth point ?

There are sharp differences of opinion on this score. The Gandhian economists favour the labour intensive Khadi and Village Industries, as its employment generating capacity is estimated to be eight times more than large industries[7]. The Karve Committee mentioned earlier, had also recommended the spread of small industrial units. A World Bank policy paper pointed out that the establishment of effective group organisations such as farmers' associations and co-operatives should have high priority. They provide the best means of lowering the cost of delivering services and marketing output, so that large numbe rs can be reached[8]. The Government of India's Rural Industries Project Programme emphasises the small scale in production while the policy towards sugar cane processing with modern technology is dealt with separately.

Another World Bank study points out that agro-industry in a developing economy contributes significantly in four ways transforming raw agricultural products into finished products for consumption, constituting a sizable proportion of the manufacturing sector, providing for exports and providing the calories and nutrients critical to the well-being of an expanding population[9].

Sugar cane processing is an important agro-industry with important backward linkages. In a study relating to Surat district, Gunvant M. Desai and Michael G. G. Schluter have shown

that the labour requirements for sugar cane cultivation amounted to 176 man days per year as against 137 for paddy-wheat, 125 for paddy-val, 119 for banana-wheat and 113 for banna-val. Sugar cane generates additional employment of at least 39 man days even as against the most labour intensive alternative, paddy-wheat[10].

Since the sugar cane processing can be done by both traditional and modern vacum pan technologies, a careful policy has to be spelt out taking into account the socio-economic (and sometimes political) aspects of the different techniques.

This paper's scope does not cover the cost and productivity differentials of the traditional and modern technologies for the processing of sugar cane. The paper has attempted to study the impact of the establishment of the sugar factory (vacuum-pan sugar) on the region, in terms of the number of workers engaged in manufacturing/ non-agricultural operations as these activities are likely to increase with rural industrialisation.

As has been pointed out, "It is futile to minimize the significance of large scale sophisticated production processes under the existing conditions of our national economy. Modern industry, with its sophisticated technology and elaborate management methods, has certainly proved itself the most efficient and cheap way of manufacturing large quantities of products required by markets. Dismantling the infrastructure or slowing down its growth for the sake of smallness as such, is obviously an untenable proposition"[11].

The establishment of a successful sugar factory implies the employment of both skilled and unskilled workers, commercialisation of farming, particularly of sugar cane and the concomitant development of ancillary services including transport and communication. Apart from these, other related industries may develop as skilled labour is now readily available and adaptable to new products and new techniques.

The new industrial policy of the Government of India (1980) envisages the establishment of nucleus plants in backward areas to act as catalyst for further economic growth of the region. The idea is to establish basically large and medium sized units in public and private sectors which in turn would generate a number of ancillaries in secondary and tertiary sectors. The policy statement says "The nucleii will also ensure a widely spread pattern of investment and employment and will distribute the benefits of industrialisation to the maximum possible. The nucleus plants would also work for upgrading the technology of small units ... and will contribute considerably towards dispersal of industry and growth of entrepreneurship"[12].

The government has spelt out the concept now but the sugar factory as the nucleus in a backward region and as the focus of all economic activity of the region is nothing new. As Galbraith says, we often do in practice what we only later find to be justified in principle[13].

The Sugar Industry Enquiry Commission, 1974 under the chairmanship of Justice V. Bhargava recognised the importance of the sugar factory in the rural sector. The Committee notes that of the 218 units working in 1969-70, spread through-out the length and breadth of the country, a large number are located in those areas which are even today considered, on the basis of the norms suggested by the Planning Commission, as 'backward areas'. And every factory is located in a rural area on account of the nature of processing involved in the manufacture of sugar. Of tne 218 units, 100 or nearly 46 per cent are located in backward districts[14]. The industry deals with hundreds of thousands of small growers the number of suppliers to a single unit ranging between 3,000 to 40,000, the average number of growers feeding a sugar factory in the tropical region being about 3,000 while that in the sub-tropical region being 25,000[15]. The growers being their supplies in small quantities, which has to be processed immediately to avoid the inversion of sugar. This whole system of procuring cane, transporting it to the factory and crushing it, involves organisational task of tremendous magnitude involving technical and managerial skills and entrepreneurial ability. The sugar factory itself employs permanent and seasonal permanent workers and, in addition, temporray workers are hired during the crushing season. A factory with a crushing capacity of 1,500 tonnes per day can employ as many as 900 permanent workers and the number of temporary workers range between 80 and 2,100. Generally speaking in the sub-tropical North more workers are employed than in the tropical

Maharashtra and South.[16]

Estimated average daily employment in sugar factories increased from 1,22,000 in 1973 in 238 factories, to 1,29,000 in 1974 in 240 factories and to 1,31,000 in 1975 in 249 factories[17].

Average daily employment during a year for each factory is derived by dividing the total attendances during the year by the total number of the days worked by the factory that year. Total is then derived by adding up the reported/estimated figures of average daily employment.

Sugar factory is just one unit of one industry. There may be other units of other related industries which may spring up in course of time, due to the establishment of the sugar factory, which provides the growth stimulus.

Index of Industrialisation : What are the indicators of industrialisation of a rural area ?

One indicator of the rural industrialisation can be an index computed as the ratio of the number of industrial workers in the location to the number of such workers in the larger area surrounding it, namely the taluk. An increasing value of the ratio, over the years, represents the development of the location while a constant or declining value does not necessarily indicate lack of development of the location.

Twenty nine factories established in the fifties were selected for studying the trend in this ratio[18]. District Census Hand Book of the Censues of 1951, 1961 and 1971 provided the data on the number of industrial workers in the location and the taluk. It was possible to obtain data only for 23 out of 29 locations. It was also not possible to include the 1981 census data for these locations; for one thing the data are not yet ready and then it is learnt from the Census Commissioner's office, that it is a matter of chance that data will be collected for the same locations. Hence this analysis is based on data for the three census years only, namely, 1951, 1961 and 1971. These data are presented in the Table in the Appendix.

Data and Related Problems

Since the factories were established mostly subsequent to 1950, the 1951 census data provides a valid base for the comparison of situation before and after the establishment of the sugar factory. However, there are problems of comparability, for the definition of workers as well as the industrial classification utilised in the three censuses differ from one another. This renders the comparison inaccurate. In order to obviate this difficulty it is proposed to analyse the data only at the global level in terms of the broad industrial categories adopted in three censuses. Even at this level there are some anamolies. Category IV of 1951 includes under "Production other than cultivation" all persons including dependents who derive their principal means of livelihood from it. There is also no separate classification of persons engaged in 'Household Industry' in the 1951 census.

In the 1961 census categories IV and V covered respectively "workers at Household Industry" and "workers in "Non-Household Industry", while in the 1971 census these were classified as categories V(a) and V(b), bifurcating workers in "Manufacturing, Processing. Servicing and Repair" under "Household Industry" and "other than Household Industry" respectively, Though 1961 and 1971 categories, referred to above, appear to be comparable on the surface, the comparison suffers from the fact that the Household Industry of 1961 includes also workers in "Livestock, Forestry and Plantations", whereas the 1971 category V(a) excludes these. In view of these limitations the attempt made here to compare the ratios should be taken as preliminary and indicative rather than conclusive.

However, the increasing value of the index in most of the cases considered here tends support to the hypothesis that the establishment of a viable sugar factory in a rural/backward region tends to act as a "growth point", resulting in the industrialiation of the area in question.

The Table in the Appendix gives the index of industrialisation for the 23 sugar factories located in the various states for the census years 1951, 1961 and 1971. The Table shows that 19 out of the 23 locations show a rising trend in the index despite the limitations of concepts and classification.

Even in those cases where the indices do not show this rising trend, a possible reason for it may be that other locations have acquired

greater industrial importance in the taluk, accentuated by possible migration of surplus workers from the sugar location in the taluk to other centres in the taluk.

The four locations showing a declining value for the index are : Nizamabad in Andhra Pradesh, Bardoli in Gujarat, Panipat in Haryana and Pettai Vai Thalai in Thiruchirapalli district in Tamil Nadu.

It is noteworthy that out of these four the first three are townships where sugar manufacture is just one of the many industrial activities and it is possible that the other industrial activities might have lost their importance when other towns in the same taluk acquired greater importance.

The only village showing a declining value of the index is Pettai Via Thalai in Tamil Nadu. Even here, although the taluk shows greater industrialisation in terms of workers than the location, the number of workers in the location itself has gone up from 439 in 1961 to 469 in 1971.

All the eight locations of Maharashtra considered here show arising value for the index, whether the location is a village or a town. It is well known that Maharashtra acquired its importance in the sugar industry in the sixties and seventies and it is also known that the sugar co-operatives in Maharashtra have more often than not completely transformed the area surrounding the sugar factory, initiating, encouraging and guiding other industrial activities. The present analysis lends support to this.

This analysis further lends support to the view that sugar manufacturing activity may well initiate development of backward regions for example, Andaman and Nicobar Islands are well suited agro-climatically for sugar cane cultivation. There is no reason why in such locations sugar factory can not be a viable unit spearheading the economic transformation of the area.

The Bhargava Commission, has pointed out that while sugar factories in many locations have promoted socio-economic development, they can not usurp the developmental role of the government. "It is neither possible nor desirable. They, like other economic institutions in the area, are expected to supplement efforts of the government.....If the government gives incentives to induce the factories to perform these tasks, such institutions can serve not only the growers and the labour but can also develop into centres for education and progress of the whole population in the area from which the factories derive their cane[19].

In conclusion it may be stated that for rural industrialisation as a means of income and employment generations, an approach based only on traditional technology and products produced on small scale units is neither necessary nor desirable. An open mind and a judicious mix will go a long way in bringing about the needed rural transformation.

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Table : Index of Industrialisation

State	Location		Town (T) Village (V)	Year of Establish-ment	1951		Ratio
	Taluk	Place			No. of Industrial workers in		Col. (5)/ Col. (6)
					Location	Taluk	
(1)	(2)	(3)		(4)	(5)	(6)	(7)
Andhra Pradesh	1. Naraspur	Pallcole	(T)	1955	3733	29552	0.126
	2. Pithapuram	Pithapuram	(T)	1951	3276	23132	0.142
	3. Srikakulam	Amadalavalasa	(V)	1960	365	19769	0.018
	4. Nizamabad	Nizamabad	(T)	1951	10808	15091	0.716
Gujarat	5. Bardoli	Bardoli	(T)	1956	1725	3710	0.465
	6. Kodinar	Kodinar	(T)	1958	1705	7662	0.225
Kerala	7. Thiruvalla	Thiruvalla	(T)	1948	3087	43531	0.071
Maharashtra	8. Kopargaon	Kopargaon	(T)	1955	1726	17557	0.098
	9. ,,	Kolgaon Thadi (Kolpewadi)	(V)	1955	154	17557	0.009
	10. ,,	Ranjangaon Kh.	(V)		18	17557	0.001
	11. Karvir	Shahunagar (Parite)	(V)	1958	21	38445	0.001
	12. Hatkanangale	Ichalkaranji	(T)	1958	11786	25091	0.470
	13. Indapur	Bhavaninagar (Sansar)	(V)	1956	248	14301	0.017
	14. Phaltan	Phaltan	(T)	1957	2912	11607	0.251
	15. Miraj	Sangli	(T)	1958	2790	27861	0.351
Mysore	16. Shrinoga	Shrinoga	(T)	1957	7734	10869	0.711
Haryana	17. Rohtak	Rohtak	(T)	1956	9504	29628	0.321
	18. Panipat	Panipat	(T)	1957	10667	27919	0.382
Punjab	19. Malerkotla	Dhuri	(T)	1955	952	15777	0.060
	20. Jullundur	Bhogpur	(V)	1955	315	67856	0.005
Tamil Nadu	21. Maunargudi	Vadapathimangalam	(V)	1955	110	8302	0.013
	22. Thiruchirapalli	Pettai Vai Thalai	(V)	1958	N.A.	N.A.	N.A.
	23. Volumulpet	Agrahora Kounadiputhur	(V)	1959	N.A.	N.A.	N.A.

Source : 1) District Census Handbooks of 1951 and 1961 Censuses.

2) Data for 1971 are obtained from the respective Directors of Census Operations.

Appendix

1961 No. of Industrial workers in		Ratio	1971 No. of Industrial workers in		Ratio
Location	Taluk	Col. (8)/ Col. (9)	Location	Taluk	Col. (11)/ Col. (12)
(8)	(9)	(10)	(11)	(12)	(13)
2738	23160	0.118	2453	12866	0.191
2466	15193	0.162	1656	7823	0.212
262	12063	0.022	652	7408	0.088
8983	22312	0.403	8715	23391	0.373
931	2951	0.315	1731	6341	0.273
1206	2882	0.418	1295	2972	0.436
519	4784	0.108	780	5796	0.135
934	9862	0.095	1534	9371	0.164
64	9862	0.006	127	9371	0.014
464	9862	0.047	N.A.	N.A.	N.A.
290	23184	0.012	350	25876	0.014
13225	24915	0.531	18289	29912	0.611
272	11486	0.024	383	6209	0.062
1610	5988	0.269	1751	4227	0.414
6950	19394	0.376	18730	20679	0.906
2911	5734	0.508	6060	7718	0.785
4429	17411	0.254	5065	13167	0.385
8478	19228	0.441	7730	14945	0.309
1451	16653	0.087	1418	12172	0.116
234	39587	0.006	277	41500	0.007
639	7079	0.090	428	6078	0.070
439	44602	0.010	469	52614	0.009
435	13351	0.033	466	13672	0.034

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Governmental Efforts in Family Planning Programme—Marketing Orientation Envisaged

ABHAY EKBOTE
Management Consultant, Institute of Public Enterprise, University Campus, Hyderabad

This article analyses the evolution of the family planning programme in India. It brings out the salient features of the government's policies and implementation procedures since the inception of the programme. Highlighting the gravity of the situation, the article advocates for the need to adopt a marketing approach towards the family planning programme rather than a sales approach, as has been practised by the government. The article concludes by identifying the areas in which marketing principles can be effectively applied so as to achieve the targetted growth rate and as a possible solution to the burning problem of population explosion in India.

India maintains the second place as the most populated country in the world. It also continues to have staggering growth rate of around 2% in population per annum. What is more, poverty malnutrition, etc. continue to remain as a suffix with the subcontinent's name. According to estimates, every second person in rural India (which constitutes more than 75% of the total population of 600 million) lives below the poverty line as against every fourteenth in the urban area. In terms of minimum expenditure of Rs. 40/- a month, 7 out of 8 persons in the villages live below the poverty line. In fact the percentage of Rural population living below the poverty line has in creased from 52% in 1960-61 to over 70% in 78-79. The problem of population explosion in India poses not only a threat to economy but imposes a strong constraint on the survival of the nation itself through the spiralling consumption of limited resources.

The gravity of the situation is supported by the World Bank President, Robert McNamara's address to the Masachussettes Institute of Technology on population growth where he said, "Short of thermonuclear war itself, the issue of population growth is the gravest that the world faces over the decades immediately ahead for it is intrinsically less subject to national safeguards and less amenable to organised control. The population growth of the planet is not in the exclusive control of the government, but rather in the hands of literally hundreds of millions of individual parents who will ultimately determine the outcome. This is what makes the population threat even more than the nuclear threat, diffuse

and intractable. And that is why it must be faced like a central determinant of mankind's future and one requiring far more attention of the world community than it is presently receiving."[1]

That the problem of population growth gains paramount importance in the Indian context is made clear from the population projections made by the Planning Commission Expert Committee in its interim report. With a birth rate of 33 per thousand and a death rate of 14 per thousand, the growth rate is about 1.9 per cent, implying an annual addition of 12 million to the population which already was 634 million in March 1978. The present rate implies two births every two seconds or 21 million births every year. Based on the assumption that the birth rate will decline to 29.5 by 1986 and to 27 by 1991 and the death rate to 11.6 by 1986 and 10.4 by 1991, the population is projected to rise to 697 million by 1983, 761 million by 1988 and 799 million by 1991.[2]

Family Planning in India :

The Government of India took official cognizance of the population problem in 1951, when the Planning Commission appointed a committee on population growth and family planning. The overall objective of the family planning programme was to secure voluntary acceptance of a small family norm and provide contraceptive services to about 100 million target couples in ranging stages of their reproductive lives scattered in about 3000 towns and 5,67,000 villages.

Family planning was introduced during the first five-year plan, with a clinical approach which consisted of dispensing advice in family planning in government hospitals and rural medical centres. The main objective of this approach was to provide family planning services to the masses with the establishment of clinics at various places. The methods mainly advocated were Rythm, Abstinence and use of imported mechanical contraceptions like condoms, jellies, diaphrams, foam tablets, etc. The clinlcal approach was continued during the second five-year plan. In 1956 there appeared a central Family Planning Board chaired by the Minister of Health. By 1959 a Director of Family Planning was named who was to be responsible to the director general of health services. Based upon the findings of a high level survey, The Mudaliar Committee (whose report published in 1961), held that the programmed action was insufficient.[3] The Director of Family Planning consequently, in April 1963, presented a detailed blue-print for what was termed as "The reorganised or extended family planning programme".[4]

The extension approach emphasised extention education, greater availability of contraceptive supplies and less dependence on traditional clinical approach. In addition there were to be better statistics and evaluation, and much stronger 'ladder' of organisation and supervision.[5] The extension approach aimed at embibing the concept of birth control, family planning and health services nearer the customers through Primary Health Centres and government clinics. It also aimed at conducting an intense educational, motivational and communication campaign which would make people overcome their inhibitions on free and open discussion on all aspects of family planning. From 1965 onwards the 'Cafeteria' approach to family planning was adopted in place of the extension approach. This approach gave the consumers full freedom of choice to adopt any method they deemed fit and safe.

The increasing importance given to the family planning by the Government of India can well be judged from the increasing tempo of the programmes in the Five Year Plans as evidenced from the expenditures on family planning.[6]

Plan	Outlay in Million Rupees	Expenditure in Million Rupees	Difference
1st 1955-56	6.5	1.45	(—) 5.05
2nd 1956-61	49.7	21.56	(—) 28.14
3rd 1961-66	269.7	248.60	(—) 21.10
Extension Plan 1966-69	829.3	704.64	(—)124.66
4th 1969-74	2857.6	2844.33	(—) 13.27
5th 1974-79	4973.6	—	—

It can, however, be noticed that there exsits a vast difference between the outlay and expenditure on family planning services. Even in terms of achievements one may easily find that the programme as such has not been able to achieve the targets. The operational targets of the fifth Plan involved a little over 18 million steralizations, nearly 6 million IUD insertions and about 9 million conventional contraceptive users by 1978-79. Against this, during the first four years of the

plan 13.3 million steralizations and 2.1 million IUD insertions were performed and the number of contraceptive users at the close of the period amounted to around 3 million.[7]

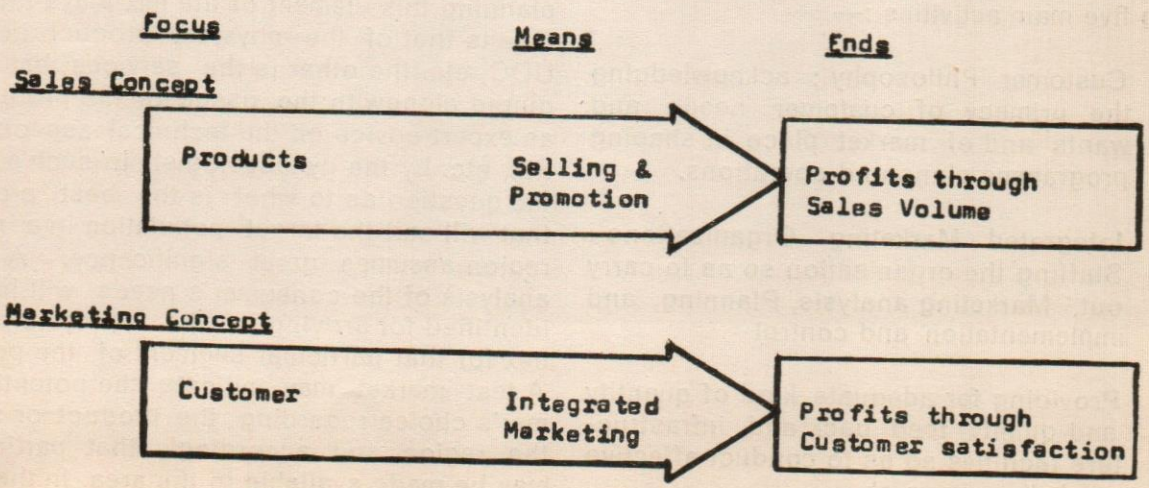
Viewing the Family Planning Programme From a Marketing Angle :

Several studies in the field of demography, medicine, sociology and mass communication have been undertaken with reference to family planning problems and various strategies have been suggested to solve the problem of population explosion. The suggestions varied from adopting a vigorous and penetrative advertising and distribution policy for *Nirodh* to bold steps such as grade tax penalties with fourth birth no maternity benefit for those who refuse to limit their progeny, etc.[8] All these suggestions seem to be a temporary relief to the dreadful disease and no permanent solution seems to be in sight.

N.A. Martin in his article : 'The Outlandish Idea : How a Marketing man can save India, emphasizing the problem of family planning as a marketing one, says, 'Selling birth control is as much a marketing job as selling any other product. Marketing has not been effectively used in large scale socio-economic planning..... Planners have gone ahead blithely without understanding the marketing principles that must determine the character of any campaign of voluntary control. The planners have ignored the importance of "Customer Service". They have proceeded with grossly inadequate and under trained staff. They have been blind to the importance of advertising and promotion.[9] Farely and Leavitt have made similar observations when they commented that marketing skills might not only be useful to family planning programme managers but also prove more relevant today because many of the problems dampening the programme development have major marketing components.[10]

At this point it may be worthwhile to note that a clear understanding of the concept of marketing becomes a prerequisite for the application of marketing principles to family planning services. According to Farely and Levitt, "Marketing involves designing a product or service to meet the needs of a target population of potential users, providing information about the product, motivate people to want it actively, making it available in an attractive way and attracting reasonable terms of trade considering the resources of the target population."[11]

It needs to be emphasised that marketing does not end with the finalisation of sale. It is something more than that. This something more is called 'After Sales Services' in a consumer durable or industrial product and would include the post operative care or advice in family planning services. The Marketing concept has been misunderstood by many and has been thought of as a synonym to sales concept. However, it must be clearly understood that the two concepts are different from each other. The sales concept emphasizes Sales Volume' while the marketing concept achieves its profits through customer satisfaction by means of 'integrated marketing approach.' The difference between the two concepts can be read clearly from the following figure :—[12]



A marketing approach would mean an objective, systematic evaluation of all the components of the marketing mix, namely, product, place, price and promotion. The marketing approach would try to analyse the behaviour of the target audience in response to the stimuli which they are subjected. It would involve the services of perceptive and practical psychologists and sociologists who have a keen insight into individual and group behaviour, who can forsee changes in behaviour that develop in a dynamic world, who have the ability of building well-knit programmes because they have the capacity to visualise the probable response of consumers, supplemented by their skill in forecasting marketing response to the marketing moves supplemented by further skill devising and using tests and measurements to check consumer response to these programmes.[13]

If one were to closely observe the evolution of the family planning programme through the years one would be inclined to conclude that the whole programme lacked a marketing approach. Since the inception of the programme, only one or two variables in the marketing mix was emphasised at a time. For intance, in the beginning only 'Clinics' were promoted, then only '*Nirodh*' marketing was emphasised and so on and so forth. A meagre interest was shown in developing planned strategies for market segmentation. Field work was given more importance than desk work, and they preferred to sell contraceptives instead of finding out the preferences, tastes and attitudes of the prospective consumers.

Marketing Strategy in Family Planning :

A marketing strategy will emphasise the following five main activities :—

1. Customer Philosophy : acknowledging the primacy of customer needs and wants and of market place in shaping programme plans and operations.

2. Integrated Marketing Organisations : Staffing the organisation so as to carry out, Marketing analysis, Planning, and implementation and control.

3. Providing for adequate kind of quantity and quality feed back and infrastructure facilities so as to conduct affective marketing research.

4. Generate innovative strategies and plans for long run growth, profitability in terms of bringing down the birth rate.

5. Providing for the marketing facilities so as to implement the plans in a cost effective manner and also take rapid corrective action when necessary.

The integrated marketing approach would mean blending the different elements of marketing mix namely : Product; place, price and promotion (known as the four P's of marketing) in a judicious manner so as to achieve the most effective strategy in the given circumstances. It may however be noted that no single mix can indiscriminately be applied to every product or service. Different mixes have to be applied for different products, depending upon the product characteristics, the industry, the market behaviour etc. Further, marketing mix for services are quite different from those of products. For example the elements of marketing of *Nirodh* in rural areas would include communication programme, involvement of the peer group, setting up of modus of the programme at the district, village, and block level, publicity programme, distribution arrangements, motivational programme, control and appraisal and extension,[14] while in urban area the elements would differ. Sales volume and profits are more likely to be maximised or the targets reached if the marketing mix is suited to the particular markets, or organisation. The implications of the marketing mix in the family planning services would cover the following :

Product : Perhaps the important element of the marketing mix is the product itself. In family planning this element of the mix plays a dual role. One is that of the physical product i.e. *Nirodh*, UDC, etc. the other is the services that are required alongwith the usage of the product such as expert advice on the technical aspects of IUD, Pill, etc. by the gynaecologist. In such a situation the question as to what is the best product mix that will suit the target population in a particular region assumes great significance. A detailed analysis of the consumer's needs will have to be identified for arriving at the appropriate product mix for that particular segment of the population. A test market may indicate the potential customer's choice regarding the product or service in the region and accordingly that particular mix may be made available in the area. In the absence

of such an information it would be detrimental to have a blanket policy of promoting only one product in the region. This approach was practised for promting *Nirodh* in India. However, of late, the government has done considerable research on the perference of consumers and has changed its promotional policies. It would be very interesting to note the choice of brand name, and its implications on the consumer behaviour. 'Preethi' which means 'happiness' is the brand name given to the condom marketed in Shri Lanka, and 'Mithuri' which means 'friend' is the brand name given to the oral contraceptive pills in Sri Lanka. These two names are associated with pleasant things and as such gain to a certain extent a pleasant reaction from the customers. In Bangladesh the Brand names given to these products are 'Raja' and 'Maya'. Whereas *'Nirodh'* which means obstruction connotes a negative approach. This particular brand name *'Nirodh'* does not attract as much a pleasant reception from consumers as 'Preethi' or 'Mithuri' used in Sri Lanka or Raja and Maya in Bangladesh.

Place : It is common knowledge that any marketing strategy would start from an effective segmentation of the market. In family planning, two distinct segments can be identified, namely the urban and the rural market. It may be noted that these two segments require a different approach for marketing contraceptives. It would be dangerous to merely add some modifications to the programme conceived for urban areas and attempt to adopt it for the rural areas. Unfortunately this point seems to have been overlooked by the government in its programme. In the urban areas the stress is to be on promotion, as demand as well as awareness already exists. But the crux of the problem of marketing of contraceptives in rural areas is of *generating demand*. This calls for a fresh marketing approach related to the rural environment. For example, the location of the PHC's and clinics has to be so arrived at, that the maximum number of people can make use of the facilities made available. Just as the location of a manufacturing unit decides the very existence and continuance of the industry so also an approapriate location of the clinics makes the job of distribution and communication easier and faster.

Promotion : It consists of advertising, personal selling and sales promotion. Family planning, which is considered something very personal and not to be discussed in public throws a challeng to the marketing man. With a hypersensitive attitude or a non-receptive behaviour of the average Indian consumer coupled with a higher level of illiteracy the job of the marketing man in promoting the product or service and convincing people of the importance and utility of a small family norm itself becomes a herculean task.

The promotion policy of the government is designed to make the prospective consumers aware of the campaigns objective, namely, general acceptance and practice of family planning. A study conducted by ORG 1978 reveals the effectiveness of the promotional campaign as regards awareness. The following table gives the percentage of the population who are aware of the *Nirodh* and Condom:[15]

Awareness of Nirodh and Condom

Awarness among	Nirodh	Condom
Urban couples	52.2%	52.6%
Rural couples	17.6%	19.6%

It is clear from the above table that the promotional policy has succeeded only in making 18% and 20% persons aware of *Nirodh* and Condom in the rural areas wherein lives more than 70% of the population of the nation. Even in urban areas the promotional policy was successful in creating awareness among only about 50% of the population. The aspect of motivation is lacking in the promotional strategies adopted by the government, especially in the rural areas. This lacuna constitutes one of the main reasons for the failure in the promotion of family planning.

The marketing plan for the purpose of family planning promotion, prepared by I.I.M , Calcutta, admits that all the information material like posters, films, and jingles had been produced without basing them on any advertising or communication plan; the slogan, "only two will do" is ambiguous and lacks answers as to why not only one or three ? If these posters are supplemented by brief facts highlighting the undesirable consequenccs of a large family and the benefits of a small family, there is every possibility that this may lead to rapid motivation towards acceptance of small family norm.[16]

As mentioned earlier, the government has been following a blanket type of advertising for its family planning programme, i. e., one slogan, one message carried all over India, translated into various regional languages. But it should be noted that the target audience to which this slogan was addressed was a hetrogenous group having different life styles, behaviour patterns, religious beliefs, etc. Therefore, the effectiveness of such a slogan would considerably be reduced since not all the people would have the same reception or reaction to the slogan. However, recently there has been some different slogans with appeals aiming at different segments of the target market. A more appropriate policy would be to decentralise the advertising and promotion strategy. Different slogans appearing to the different segments of the target population may prove more effective. This is because different people would perceive family planning in a different manner. How a higher income group consumer in an urban area views the concept will be different from the views of a middle-income or a lower-income level consumer in the urban area. Similarly, at the district and village level the perception of the concept varies from district to district and perhaps village to village. Even their reaction to the family planning advertisements and to the concept itself would widely differ because of their varied social, cultural and religious background. These aspects do not seem to have been considered in the framing of the advertisements by the government and as such reflect a lack of marketing orientation.

Price : In a competitive market, price as a component of marketing mix becomes very important in the decision making process. Apart from competition, product quality, purchasing power of the consumer and his willingness to pay are some of the prime factors in determining the price of the product or service. How does pricing affect the sale of family planning products ?

Marketing of family planning services must take the form of 'social marketing' in the rural areas and commercial marketing in the urban areas.

Consequently pricing of the family planning services should reflect the social and economic functions. Pricing takes the form of a 'promotional tool' when the products and services are made available to the prospective consumers free of cost. Incentives include payment in cash or kind for vasectomies or lubectomies. This policy of the government is a commendable one. The government has done well to keep the price of *Nirodh* low. This policy of maintaining the price line within affordable limits of the consumer has given a good impetus to the family programme.

However, these methods have achieved only a partial success. While it is true that 14 to 15 per cent of the reproductive couples have been converted in favour of planning and that one out of every ten reproductive couple is currenlty using contraceptives, these efforts by themselves are not adequate to lower the birth rate to 25 as planned in the next ten years. To achieve this target about 70 to 80% of the reproductive couples will be required to use contraceptives. regularly.

A differential pricing policy, i. e. providing superior quality with higher price has to be marketed on a commercial lines in the metropolitan and Class I towns where the purchasing capacity of the consumer is high. The profits thus reaped have to be channalised for subsidising the promotional activites to be undertaken in the rural areas. Therefore, price itself will become a tool for promotion of the service.

Conclusion

The current growth rate in population with over 23 million added every year is mounting tremendous burden on the Indian economy. By the turn of the century the population is expected to reach 100 million mark. This will have negative repercussions on the economic growth. Although the government is aware of the intensity of the problem and has allocated huge sum of money in its Five Year Plans for the promotion of family planning, the targets were far from reach at the and of all the plans. The family planning programme no doubt has made a significant impact on the urban population-particularly the educated an comparitively the better off sections of the society, but the programme has failed to reach the rest of the majority of the rural areas who seem to be going on prolifically under the traditional belief that more babies mean more hands for work. Family planning cannot make much headway until this attitude is changed. It may be noted that the crux of the problem is

not mere selling of *Nirodh*, but it is "the selling of the idea of family planning, about the benefits of small family and convincing the masses of the importance and need for a small family". This, however, is not a simple task, especially when the majority of the Indian population is in rural area, bound by traditional beliefs, customs and inhibitions, which prevent them from practising family planning. The marketing man has the requisite tools to analyse the consumer behaviour, prepare the necessary promotional plans best suited to the different market segments to attain the desired results. He is in a better position to convince the rural prospective consumers for the need of a small family norm as he knows what the requirements of a rural couple are. He understands their socio-economic and religious background and accordingly is in a position to prepare a marketing strategy to convince them on the importance of a small family. He is in better position to get the messages across because he is well a ware of the various stimuli which will help get a quick response from the poor and illiterate rural man.

It is relatively easy to convince people who possess knowledge and who have skills but it is very difficult to change age-old customs and beliefs. Only a scientifically designed marketing strategy based upon the analysis of consumer behaviour and inplemented in all its aspects will be able to provide a satisfactory solution to the burning problem of family planning in India.

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Computerised Production Scheduling

Dr. S. K. GUPTA
Reader in Production Management at the Faculty of Management Studies, University of Delhi

The objective of this paper is to give a computer programme, written in FORTRAN IV, which can be used to solve large size scheduling problems effectively.

A production schedule specifies the times at which the jobs in a production department should be processed on the machines available in that department. A large number of mathematical models, some of which are listed in the references, are available to solve the scheduling problems. However, a practising manager finds it difficult to use these models because of the complexity involved in solving the model when the problem size increases.

The mathematical details of the programme, are available in Gupta and Swarup (9). This programme does not guarantee an optimum solution. However, by conducting experiments on computer, it has been established that it gives results which are comparable with other existing methods. It is expected that this method should give an efficiency of about 0.979, where, efficiency has been defined as the ratio of the optimum solution to the solution provided by this technique Table 1 gives the average efficiency for the various techniques available in the literature.

Table 1

Source	Overall average Efficiency* %
Ashour (1)	93.90
Ashour and Parker (2)	94.00
Ashour and Hiremath (3)	95.77
Gupta and Maykut (6)	94.55
Gupta and Swarup (9)	97.90

*The overall average has been calculated from the results given in the corresponding reference.

Problem Definition

The objective of this computer programme is to find the sequence in which a given number of 'n' jobs must be processed on a given number of 'm' machines so as to minimize the total time required to process all these jobs. This time is called the Schedule Time. In addition to finding the sequence, the programme also finds the actual time at which the processing of each operation of each job begins so that a Gantt chart may be prepared.

Input

The input to the programme includes the total number of jobs to be processed, number of operations for each job, total number of machines in the shop. the sequence of machines required to process each job and the processing time required for each operation of each job. A job is analogus to a work order consisting of one or more items to be processed. Processing time includes the time to set up the machine and the time to process *all* the items contained in that work order.

Output

The output of the programme is in the form of a matrix, called Start Time Matrix, which specifies the time at which the processing of each operation begins on the respective machine.

Procedure

Step 1 : Number each job to be processed as 1, 2,3, ...,n.

Step 2 : Number each machine in the shop as 1, 2, 3, ...,m.

Step 3 : Specify the sequence of machines required for each job in the form of a matrix, called Machine Sequence Matrix. Example. Consider the following problem involving three jobs and four machines.

Machine Sequence Matrix

	First Operation	Second Operation	Third Operation	Fourth Operation	Fifth Operation
Job 1	1	2	4	3	1
Job 2	3	1	2	4	
Job 3	1	3	2	4	

Machine Sequence Matrix shows that Job 1 has five operations, Job 2 has 4 operations and Job 3 also has 4 operations. The machine required for each operation has been specified in the matrix given above.

It is presumed above that the machines are not interchangeable and there is only one machine of each, type. However, in actual practice there may be two or more machines which can do the same operation. In such a situation, before Machine Sequence Matrix is specified, the machine loading decision, that is, which jobs are to be processed on which machine, is to be taken. For example, in the above illustration, suppose machine 2 and machine 3 are similar and interchangeable. An implicit machine loading decision in the above Machine Sequence Matrix is that machine 2 will be used to process the second operation of Job 1 and third operation of job 2 as well as Job 3. Similarly, machine 3 will be used to process fourth operation of job 1, first operation of job 2 and thrid operation of job 3. The assignment of jobs to such similar machines must be done in a way so that, as far as possible. the work divided equally on all of them.

Step : 4 Specify the processing times required for each operation of each job in the form of a Processing Time Matrix as given below :

Example : For the problem given at Step 3, the Processing Time Matrix may be as follows :

Processing Time Matrix

	First Operation	Second Operation	Third Operation	Fourth Operation	Fifth Operation
Job 1	30	100	70	20	50
Job 2	90	60	50	30	
Job 3	50	100	50	60	

The processing time may be in any time unit. The computer programme has been written to accept only the integer values of processing times. Non-integer values can be converted into integer values by multiplying by 10 or 100 depending upon whether the processing times are specified upto one decimal place or two decimal places.

Step 5 : Punch the computer programme and the input data in the Format (2413) as per the details given below :

For the above example, the data will be punched as follows :

Card No. 1 : NOJ, NOM, where NOJ=n and NOM=m.

Card No. 2 : SOP (I), I=1, NOJ; where SOP (I) is the number of operations for the ith job, i=1,2, ,n. If n >24, then more than one card will be needed.

Card No. 3 to (3+n—1), that is 3 to 5 : These cards contain the Machine Sequence Matrix-MSM. Each of these cards contain the sequence of machine for a particular job. If number of operations for a job is more than 24, then more than one card will be needed for that job.

Card No. (3+n) to (3+2n—1) that is, 6 to 8: These cards contain the Processing Time Matrix-PTM. Each of these cards contains the processing times for the operations of a particular job. If number of operations for a job is more than 24, then more than one card will be needed for that job.

For the example given earlier, the punching of cards will be as follows :

Card Columns	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Card No. 1			3			4											
Card No. 2			5			4			4								
Card No. 3			1			2			4			3			1		
Card No. 4			3			1			2			4					
Card No. 5			1			3			2			4					
Card No. 6	3	0	1	0	0	7	0				2	0		5	0		
Card No. 7	9	0		6	0	5	0				3	0					
Card No. 8	5	0	1	0	0	5	0				6	0					

Step 6 : Run the programme on a computer and get the output.

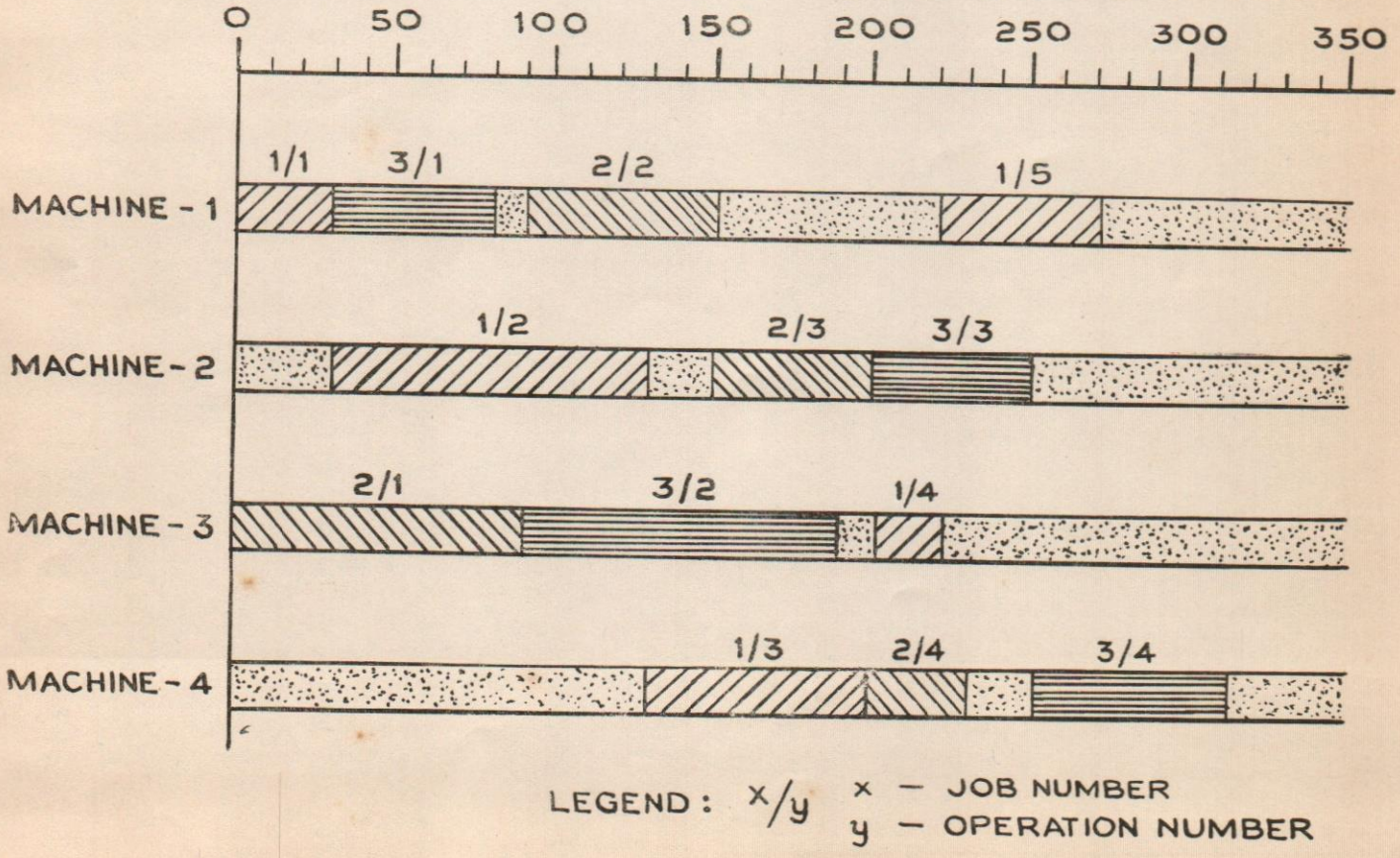
Step 7 : Prepare the Gantt Chart from the output which is in the form of a Start Time Matrix.

For the above problem, the Start-Time Matrix may be as follows :—

Start Time Matrix

	First Operation	Second Operation	Third Operation	Fourth Operation	Fifth Operation
Job 1	1	31	131	201	221
Job 2	1	91	151	201	
Job 3	31	91	201	251	

The Gantt Chart for this Start Time Matrix is given in Figure 1. Schedule time is 310 units.



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```
0001          DIMENSION RNND (100)
0002          INTEGER FTDASH,                COUNT, P, A, T, FMAX, PROENO
0003          INTEGER G (200), SOP (200), NMJ (200), MA (20), NJM (20), H (20),
            1 AU×1 (20, 400), AU×2 (20, 400) AU×3 (400), AU×4 (400), T5 (200, 40), H5 (400),
            2 TM (200, 40) STA (200, 40), JA (200), MSM (200, 40), JSM (20, 400)
0004          IBATCH=0
0005        888 READ (5, 2, END=9999) NOJ, NOJ, NOM
0006          IBATCH=IBATCH+1
0007          FTDASH=50000
0008          MAX=0
0009          READ (5, 2) (SOP (I), I=1, NOJ)
0010        2 FORMAT (2413)
0011          NOP=0
0012          IGMAX=0
0013          DO 19 I=1, NOJ
0014          IG×SOP (I)
0015          NOP=NOP+IG
0016          READ (5, 2) (MSM (I, K), K=1, IG)
0017          IF(IGMAX.GE.SOP (I) ) GO TO 19
0018          IGMAX=SOP (I)
0019       19 CONTINUE
0020          DO 199 I=I, NOS
0021          IG=SOP (I)
0022       199 READ (5, 2) (TM (I, K), K=1, IG)
            C     ALL THE INPUT DATA HAS BEEN READ INTO THE PROGRAM AT THIS STAGE.
0023          WRITE (6, 30)
0024       30 FORMAT (IH2)
0025          WRITE (6, 6) IBATCH
0026        6 FORMAT (1H 50X, 'PROBLEM NUMBER', 14,//)
0027          WRITE (6, 5) NBJ, NOM, NOP
0028        5 FORMAT (5X, 'NO.O= JOBS=', 14,3X, 'NO.OF MACHINES=', 14,3X,' TOTAL
            1 NUMBER OF OPERATIONS=', 16,//)
0029          WRITE (6, 27)
0030       27 FORMAT (1H, 5X, 'MACHINE SEQUENCE MATRIX',/)
0031          DO 37 I=1, NOJ
0032          IG=SOP (I)
0033       37 WRITE (6, 26) (MSM (I, K), K=1, IG)
0034       26 FORMAT (1HO, 2X, 3013)
0035          WRITE (6, 28)
0036       28 FORMAT (1H, 5X, 'PROCESSING TIME MATRIX',/)
0037          DO 41 1=1, NOJ
0038          IG=SOP (I)
0039       41 WRITE (6, 25) (TM (I, K), K=1, IG)
0040          DO 20 J=1, NOM
0041          H5 (J)=0
0042          DO 20 I=1, NOJ
0043          IG=SOP (I)
0044          DO 20 K=1, IG
0045          IF (MSM (I, K).NE.J) GO TO 20
0046          H5 (J)=H5 (J)+1
0047       20 CONTINUE
0048          DO 23 I=1, NOJ
0049          AUX3 (I)=0
0050       23 AUX4(I)=0
0051          DO 83 K=1, IGMAX
0052          DO 44 I=1, NOJ
0053          IF (K.GT.SOP (I)) GO TO 20
0054          MCI=MSM (I, K)
0055          AUX3 (MC1)=AUX3 (MC1)+1
0056          IC 1=AUX3(MCI)
0057          AUX1(MCI, IC1)=I
0058       44 CONTINUE
0059          DO 33 J=1, NOM
0060          AUX2 (J, K)=AUX3 (J)=AUX4 (J)
```

```
0061                33  AUX4 (J)=AUX3 (J)
                    C       LLL IS THE NUMBER OF SCHEDULES TO BE GENERATED.
0062                        P=IGMAX
0063                        LLL=10
0064                        NSTART=37129
0065                        NOINF=0
0066                        DO 999 III=1, LL
                    C       DO LOOP 800 FINDS THE SEQUENCE OF OPERATIONS TO BE DONE ON EACH
                    C       MACHINE IN THE FORM OF A MATRIX JSM, CALLED JGB SEQUENCE MATRIX.
0067                        DO 800 I=1, NOM
0068                        COUNT=0
0069                        DO 800 J=1, P
0070                        A=AUX2 (I, J)
0071                        IC=COUNT
0072                        COUNT=A+COUNT
0073                        IF(A=1) 800, 500, 200
0074                200     CALL RANDS (NSTART, RNNO, A)
FORTRAN IV      MODEL  44   MFT        VERSION 3,    LEVEL 4     DATE 81/099        /MAIN 44
0075                        ID=IC
0076                        DO 400 KK=1, A
0077                        B=5.0
0078                        DO 300 K=1, A
0079                        IF (RNNO (K). GT. 3 GO TO 300
0080                        B=RNNO (K)
0081                        IF=K
0082                300     CONTINUE
0083                        RNNO (IF)=12.0
0084                        IT=IC+IF
0085                        ID=ID+1
0086                400     JSM (I, IT)=AUX1 (I, ID)
0087                        GO TO 800
0088                500     JSM (I, COUNT)=AUX1 (I, COUNT)
0089                800     CONTINUE
                    C       NOW THE START TIME MATRIX STM CAN BE OBTAINED.
0090                        DO 7 J=1, NGJ
0091                        DO 14 K=1, NOM
0092                 14     STM (J, K)=0
0093                        NMJ(J)=MSM (J, 1)
0094                        G(JI=1
0095                 7      JA (J)=1
0096                        DO 8 K=1, NGM
0097                        NJM (K)=JSM (K, 1)
0098                        MA(K)=1
0099                 8      H (K)=1
0100                        IC=0
0101                        ICC=0
0102                 9      DO 10 J=1, NOJ
0103                        IF (G (J).GT.SOP (J)) GO TO 10
0104                        M=NMJ (J)
0105                        IF (NJM (M), NE.J) GO TO 10
0106                        IC=IC+1
0107                        L=G (J)
0108                        IF (MA(M) GT.JA (J)) GO TO 55
0109                        STM (J, L)=JA (J)
0110                        GO TO 56
0111                 55     STM (J, L) =MA(M)
0112                 56     MA(M)=STM (J, L) +TM (J, L)
0113                        JA (J)=STM (J, L)+TM (J, L)
0114                        NL=L+1
0115                        IF (NL.GT.SOP (J)) GO TO 18
0116                        NMJ (J)=MSM (J, NL)
```

```
0117                  18  G (J)=G (J)+1
0018                      H(M)=H(M)+1
0119                      T=H(M)
0120                      IF (T.GT.H5 (M)) GO TO 10
0121                      NJM (M)=JSM(M.T)
0122                  10  CONTINUE
0123                      IF (ICC.EQ.IC) GO TO 40
0124                      ICC=IC
0125                      IF (IC.LT.NOP) GO TO 9
                    C     FMAX IS THE VALUE OF THE OBJECTIVE FUNCTION, THAT IS, SCHEDULE
0126                      FMAX=0
0127                      DO 15 K=1, NOV
0128                      IF (FMAX.GT.(MA(K)=1)) GO TO 15
0129                      FMAX=MA(K)-1
0130                  15  CONTINUE
                    C     MATRIX T5 CONTAINS THE BEST START TIME MATRIX GENERATED THUS
                    C     AND FTDASH IS THE CORRESPONDING SCHEDULE TIME.
0131                      IF (FMAX.GE.FTDASH) GO TO 999
0132                      FTDASH=FMAX
0133                      DO 59 I=1, NOJ
0134                      ISOP=SOP (I)
0135                      DO 59 K=1, ISOP
0136                  59  T5 (I, K)=STM (I, K)
0137                      GO TO 999
0138                  40  NOINF=NOINF+1
0139                 999  CONTINUE
                    C     NOW THE INPUT DATA AS WELL AS THE OUTPUT CAN BE PRINTED OUT.
0140                      IF (NOINF.EQ.LLL) GO TO 1997
0141                      WRITE (6,2200)
0142                2200  FORMAT (//,5X, 'BEST FEASIBLE SCHEDULES GENERATED, START TIME
                          1 MATRIX', / /)
0143                      DO 2250 I=1, NOJ
0144                      IG=SOP (I)
0145                2250  WRITE (6,26) (T5(I,K), K=1
0146                      WRITE (6,2300) FTDASH
0147                2300  FORMAT ( / /. 5X,' MINIMUM SCHEDULE TIME=',15)
0148                      GO TO 888
0149                1997  WRITE (6,1998) IBATCH, LLL
0150                1998  FORMAT ( / /, 5X,' IN PROBLEM NUMBER', 15, 'THE SAMPLE WAS', 15, 'BUT INO FEASIBLE
                          SCHEDULE WAS GENERATED')
0151                      GO TO 888
0152                9999  CALL EXIT
0153                      END
FORTRAN IV      MODEL 44    MFT          VERSION 3,    LEVEL 4      DATE 81/099      /MAIN 44

                          SUBROUTINE TO GENERATE RANDOM NUMBERS

0001                      SUBROUTINE RANDS (NSTART, SR, N)
0002                      DIMENSION SR(1)
0003                      DO 2 I=1, N
0004                      NSTART=NSTART*65539
0005                      IF (NSTART.LT.0) NSTART=NSTART+21474+83647+1
0006                      SR (I)=NSTART*4.656613E=10
0007                  2   CONTINUE
0008                      END
```

Productivity
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Optimum Transportation Programmes For The Supply of Coal to Thermal Power Stations

R. V. KULKARNI — Lecture in Mechanical Engg. Visvesvaraya Regional College of Engineering, Nagpur.
R. D. ASKHEDKAR — Asstt. Professor in Mech. Engg., Visvesvaraya Regional College of Engineering, Nagpur.

In India, Coal is obviously the primary source of energy. Increasing attention must there are be paid to all the aspects of coal production, transportation and utilisation. An attempt is made in this paper to present an optimum transportation programme for the supply of coal to thermal power stations under a set of assumptions.

Notations

S_i = Supply available at the i^{th} coalfield, tonnes.
D_j = Demand of coal of the j^{th} thermal power plant, tonnes.
C_{ij} = Cost of transporation per unit weight from a source i to the destination j, Rs.
K = Constant of proportionality
ϕ_{ij} = Distance between the source i and the destination j, Km.
x_{ij} = Quantity of local to be supplied from the source i to the destination j, tonnes.
m = No. of rows,
n = No. of columns
AS_i = Actual supply available at the source i,tonnes.
AD_j = Actual demand of the destination j, tonnes.
R_i = Row differences, Row Nos.,
K_j = Column differences, Column Nos.,
WV = Water value.

The resource endowments of a country determine the fuels which it can use for producing energy. In India, coal is obviously the primary source of energy. Thefore, increasing attention has to be given to optimise all aspects of coal production, transportation and utilisation. Though there has been a spectacular increase in the production of coal after nationalisation, there has been a spectre of power famine, load-shedding and crippling of industries under power cuts resulting in decreased production, losses and under-capacity utilisation[1].

There are many factors which are partly or completely responsible for this situation[2]. All these factors point towards finding out an optimum distribution/transportation plan. It has therefore, been decided to suggest an optimum transportation programme for the supply of coal from various coal fields to the various thermal power stations in the country so as to minimise the transportation cost and also the time in general and to improve the functioning of the thermal power stations in particular.

Elements of the problem

The problem stated above is a standard distribution problem in Allocation Models. The various elements of the problem are :

The Supply Available at the Various Coal Fields

The production figures of all the coal fields for the current year have been obtained from the

statistical sections of the various divisions of Coal India Ltd.[3,4].

The Demand of Coal of the Various Thermal Power Plants

The megawatt capacities of the various thermal power plants are taken from the bulletin published by Central Electricity Authority[5]. In working out the coal requirement for each thermal power station, the norm of 3 tonnes of coal per annum for one KW of installed capacity has been widely accepted[6]. The same has been used in this work to calculate the requirement of coal for the thermal power plants.

The Cost of Transportation per Unit Weight from the Source i to the Destination j

Assuming that the actual transportation cost is directly proportional to the distance travelled, the distances between the sources and the destinations have been calculated and used effectively. The zonal railway time-tables and Indian Bradshaw were used to arrive at these figures.

Mathematical Formulation

The mathematical formulation of the problem will be as under :

$$C^{ij} = k\phi^{ij}$$

Therefore,

the cost of transporation $= K[\phi_{11}.x_{11} + \phi_{12}.x_{12} + \ldots + \phi_{mn}.x_{mn}]$

$$= K \sum_{i=1}^{m} \sum_{j=1}^{n} \phi_{ij}.x_{ij} \quad \ldots\ldots (1)$$

This cost is to be minimised subject to the following restrictions :

$$x_{11} + x_{12} + x_{13} + \ldots \ldots \ldots x_{1n} = S_1$$

$$x_{21} + x_{22} + x_{23} + \ldots \ldots \ldots x_{2n} = S_2$$

$$x_{m1} + x_{m2} + x_{m3} + \ldots \ldots \ldots x_{mn} = S_m$$

and,

$$x_{11} + x_{21} + x_{31} + \ldots \ldots x_{m1} = D_1$$

$$x_{12} + x_{22} + x_{32} + \ldots \ldots \ldots x_{m2} = D_2$$

$$x_{1n} + x_{2n} + x_{3n} + \ldots \ldots x_{mn} = D_n$$

These equations can also be written with simplified notations as shown below :

$$\sum_{j=1}^{n} x_{ij} = S_i, \quad \text{for } i = 1, 2, 3 \ldots m \ldots \quad \text{(ii)}$$

and $$\sum_{i=1}^{m} x_{ij} = D_j, \quad \text{for } j = 1, 2, 3 \ldots n \ldots \quad \text{(iii)}$$

The final mathematical formulation for the problem can now be written as under :

$$\text{Minimise } Z = \sum_{i=1}^{m} \sum_{i=1}^{n} \phi_{ij} \cdot x_{ij}$$

subject to,

$$\sum_{j=1}^{n} x_{ij} = S_i, \quad \text{for } i = 1, 2, 3 \ldots m$$

$$\sum_{i=1}^{m} x_{ij} = D_j, \quad \text{for } j = 1, 2, 3 \ldots n$$

$$\sum_{i=1}^{m} S_i = \sum_{j=1}^{n} D_j$$

and $x_{ij} \leqslant O \quad \ldots \quad \ldots \quad \text{(iv)}$

Assumptions

Basically this is a transportation problem. There are a few assumptions which have been made to simplify the problem and consequently its solution process. These are given below :

i) The increase in the total production of various coalfields is assumed to be in the same proportion approximately all over the country.

ii) The demand of coal for each power station is worked out on the basis of the norm that approximately 3 tonnes of coal per annum are required for one KW of installed capacity[6].

iii) Various coal mines produce coals of varying quality and similarly the coal quality requirements of the various power stations are different. It is assumed that the coal produced by the various coal mines and the coal required by the various thermal power stations are of the same quality.

iv) There are a few mines which produce the coking coal which is required for the metallurgical purposes, specially by the steel plants. As far as this work is concerned, no distinction has been made between coking and non-coking coals.

v) According to the priorities agreed upon by a high level committee, locosheds are to be given the first priority for the supply of coal and then comes the power stations at the second place in the priority list[7]. However, in this work it has been assumed that the power sector has the first priority over all other consumers of coal.

vi) As far as the actual transportation of coal is concerned there are mainly two modes available by rail and road. The third mode, by sea, is not yet fully developed. In fact the second mode, by road, is still in the developing state. The actual transportation cost is assumed to be proportional to the distance travelled so that the actual distance travelled can be minimised in order to get the optimum solution. The distance travelled between two different places is likely to be different by the different modes of transportation, but in this work it is assumed that the distance travelled by the two different modes namely rail and road will be same and hence the distances between various coalfields and the power stations have been calculated with the help of the zonal railway maps and time-tables.

vii) Singareni Coalfields and Neyveli Lignite Corporation have been excluded from this analysis because of the non-availability of data for these coalfields. Since it is known that most of the power stations in southern region are getting coal from these coalfields, it is quite imperative to exclude such power stations also from this analysis. Accordingly, the power stations at Parli (Maharashtra), Ennore and Basin bridge (Tamil Nadu) Hussain Sagar and Nellore (Andhra Pradesh) have been excluded from this analysis.

viii) The Satpura thermal power station at Sarni is getting its entire coal supply from the nearby Patharkheda coal mines through conveyor belt system. Therefore both of them, the Satpura power station as well as the Patharkheda coal fields, have been excluded from this anslysis.

Analysis

The essential requirement of any transportation problem is that the total supply and the total demand must be equal. In this case, the demand and supply were not equal and therefore, an additional demand with zero cost co-efficients was created in order to fulfil the above condition. For obtaining the optimum distribution pattern, a method of relaxation or the process of successive iteration was adopted. To start with, an initial feasible solution was developed with the help of Vogel's Approximation Method and this initial solution was then improved in stages by successive optimisation with the Modified Distribution Method.

THE OPTIMUM TRANSPORTATION PROGRAMME

Region	Name of Th. Power' Station	Demand 000 tonnes	Name of Coalfield	Supply '000 Tonnes
West Bengal	Calcutta	1237.5	Kajora	1237.5
	Bandel	990	Kajora	990
	Durgapur	870	Kajora	870
	Durgapur (WB)	855	Kajora	855
	Santaldih	1920	Dishergarh	1920
	Gourepur	105	Pandaoswar	105
Bihar	Barauni	435	Hazaribagh	435
	Patratu	1860	Ramgarh	1860
	Bokaro	742.5	Karagali	742.5
	Chandrapur	1980	Karagali	1980
Orissa	Talcher	750	Talcher	750
Uttar Pradedh	Harduaganj	1440	Kathara	743.3
			Singraulli	696.7
	Harduaganj (1)	1440	Kathara	91.3
			Singraulli	1348.7
	Harduaganj (2)	1440	Kathara	518.3
			Singraulli	921.7
	Panki	652	Singraulli	652
	Panki (1)	652	Kathara	652
	Obra	2850	Singraulli	2850
	Kanpur	225	Singraulli	225
	Kanpur (2)	225	Kathara	225
	Surajpur	20.4	Pench	20.4

Punjab	Bhatinda	1320	Kathara	1320
Haryana	Faridabad	405	Pench	405
Delhi	I. P. Station	852 3	Kathara	852.3
	Badarpur	1530	Kathara	109.6
			Pench	1420.4
Gujrat	Ahmedabad	652.5	Sohagpur	652.5
	Utran	202.5	Nagpur	202.5
	Utran (3)	202.5	Wardha	202.5
	Utran (10)	202.5	Kanhan	202 5
	Gandhinagar	720	Sohagpur	720
	Ukai	1320	Wardha	1320
	Ukai (9, 11)	1320	Wardha	1277.5
			Nagpur	42.5
	Dhuvaran	1602	Sohagpur	1602
	Sabarmati	330	Nagpur	4.5
			Sohagpur	325.5
Madhya Pradesh	Korba	1260	Korba	1260
	Amarkantak	900	Jhagarakhed	110
			Sohagpur	790
Maharashtra	Koradi	2040	Nagpur	440
			Kanhan	1600
	Koradi (10)	2040	Nagpur	642.5
			Kanhan	1397.5
	Koradi (11,12)	2040	Nagpur	482 5
			Kanhan	1557.5
	Koradi (13)	2040	Nagpur	1280
			Kanhan	760
	Koradi (14)	2040	Nagpur	710
			Kanhan	1330
	Koradi (15)	2040	Nagpur	717.5
			Kanhan	1322.5
	Koradi (16)	2040	Nagpur	627.5
			Kanhan	1412.5
	Koradi (17)	2040	Nagpur	728
			Kanhan	1312
	Koradi (18)	2040	Nagpur	507.5
			Kanhan	1532.5
	Trombay	1012.5	Wardha	970
			Nagpur	42.5
	Trombay (3)	1012.5	Wardha	767.5
			Nagpur	245
	Trombay (4)	1012.5	Wardha	130
			Nagpur	882.5
	Trombay (5)	1012 5	Wardha	692.5
			Nagpur	320
	Trombay (6)	1012.5	Wardha	782.5
			Nagpur	230
	Trombay (7)	1012 5	Wardha	682
			Nagpur	330.5
	Trombay (8)	1012.4	Wardha	902.5
			Nagpur	110
	Trombay(9,11)	1012.5	Wardha	1012.5
	Trombay (12)	1012.5	Wardha	970
			Kanhan	42.5
	Nasik	840	Nagpur	840
	Nasik (4)	840	Wardha	840
	Nasik (13)	840	Kanhan	840
	Khaparkheda	270	Nagpur	270
	Khaparkheda (14)	270	Kanhan	270
	Paras	277.5	Nagpur	277.5
	Paras (5)	277.5	Wardha	277.5
	Paras (15)	277.5	Kanhan	277.5
	Bhusawal	187.5	Nagpur	187.5
	Bhusawal (6)	187.5	Wardha	187.5
	Bhusawal (16)	187.5	Kanhan	187.5
	Chola	288	Nagpur	288
	Chola (7)	288	Wardha	288
	Chola (17)	288	Kanhan	288
	Ballarshah	67.5	Nagpur	67.5
	Ballarshah (8)	67.5	Wardha	67.5
	Ballarshah (18)	67.5	Kanhan	67.5
Assam	Namrup	334.5	Maragherita	334.5

The size of this problem was so large (22 x 38) that the solution by hand computations was practically an impossible task and hence the help of the cemputer was sought. Accordingly, two computer programmes VAMROUTE and OPTROUTE were prepared in the FORTRAN-IV language. The programmes had been written in such a way that they can be augmented to each other very easily and can be run as one complete programme. The flowcharts explaining the logic in the programme are shown in Figures 1 and 2. The two computer programmes, VAMROUTE and OPTROUTE, were combined at the time of running them on the computer. The combined programme VAMOPT was run on the DEC-System-10 at the TIFR Computer Centre, Bombay.

Results and Conclusion

The simplified optimum transportation programme developed on the basis of the computer results is shown in the table. The table consists of five columns showing the region, name of the thermal power station, the demand of coal, the name of the coalfield from where the supply should be made and finally the quantity to be supplied. Various alternative optimum solutions

are numbered systematically through-out the table so that any one of these solutions can be chosen depending on the requirement of the situation. For example, if the thirteenth alternative solution is selected, than (i) the Koradi power station will get 1280 and 760 thousand tonnes of coal from Nagpur and Kanhan coalfields as against the original planning of 440 and 1600 thousand tonnes and (ii) Nasik power station will get 840 thousand tonnes of coal from the Kanhan coalfields instead of Nagpur coalfields.

This work is probably the first attempt to tackle this problem on a logical and scientific basis. Various assumptions have been made to overcome the difficulties in the data collection and to simplify the problem. However, all these assumptions can be removed one by one by making suitable changes in the model in order to reach nearer and nearer to the real situation. The work presented here certainly provides a direction to proceed.

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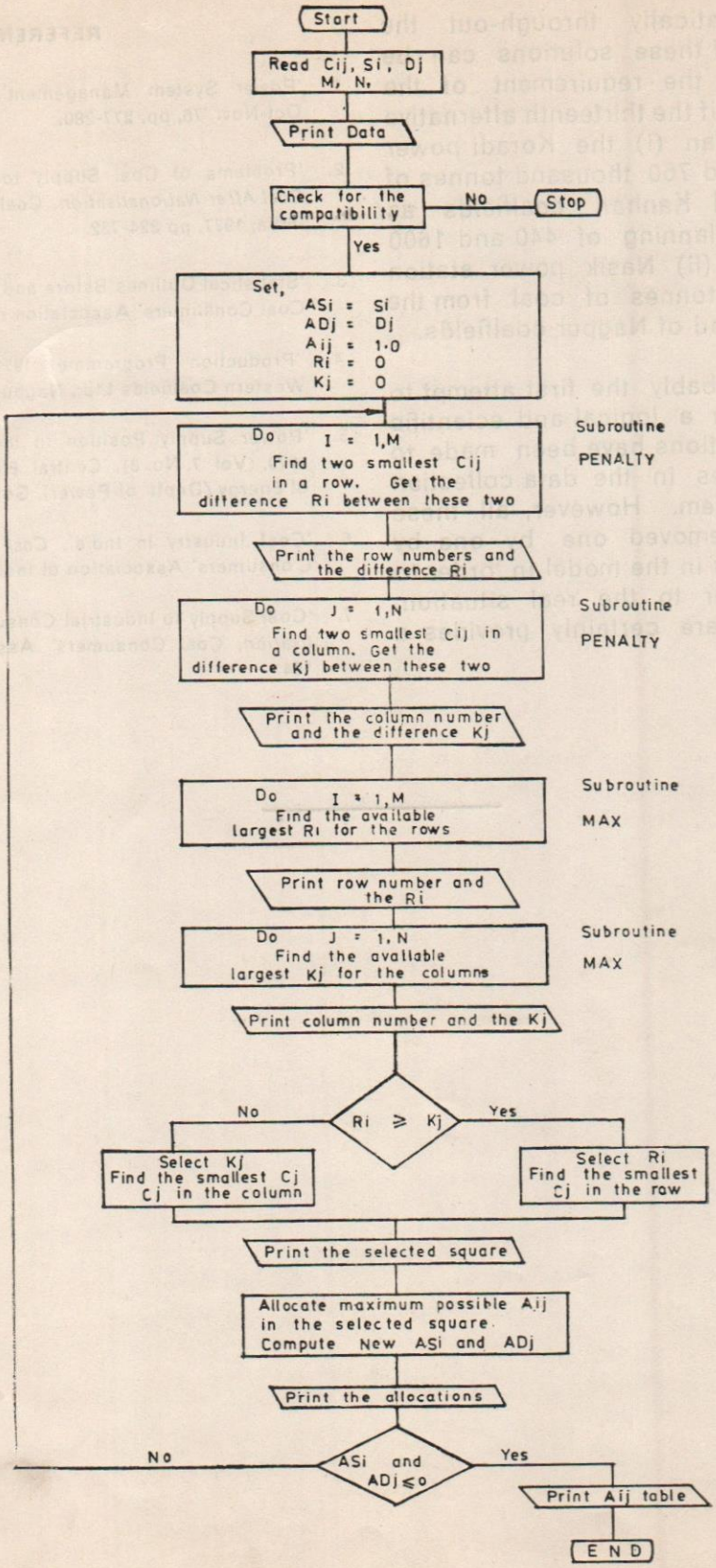

Figure 1 : Flow Chart For The Program Vanroute

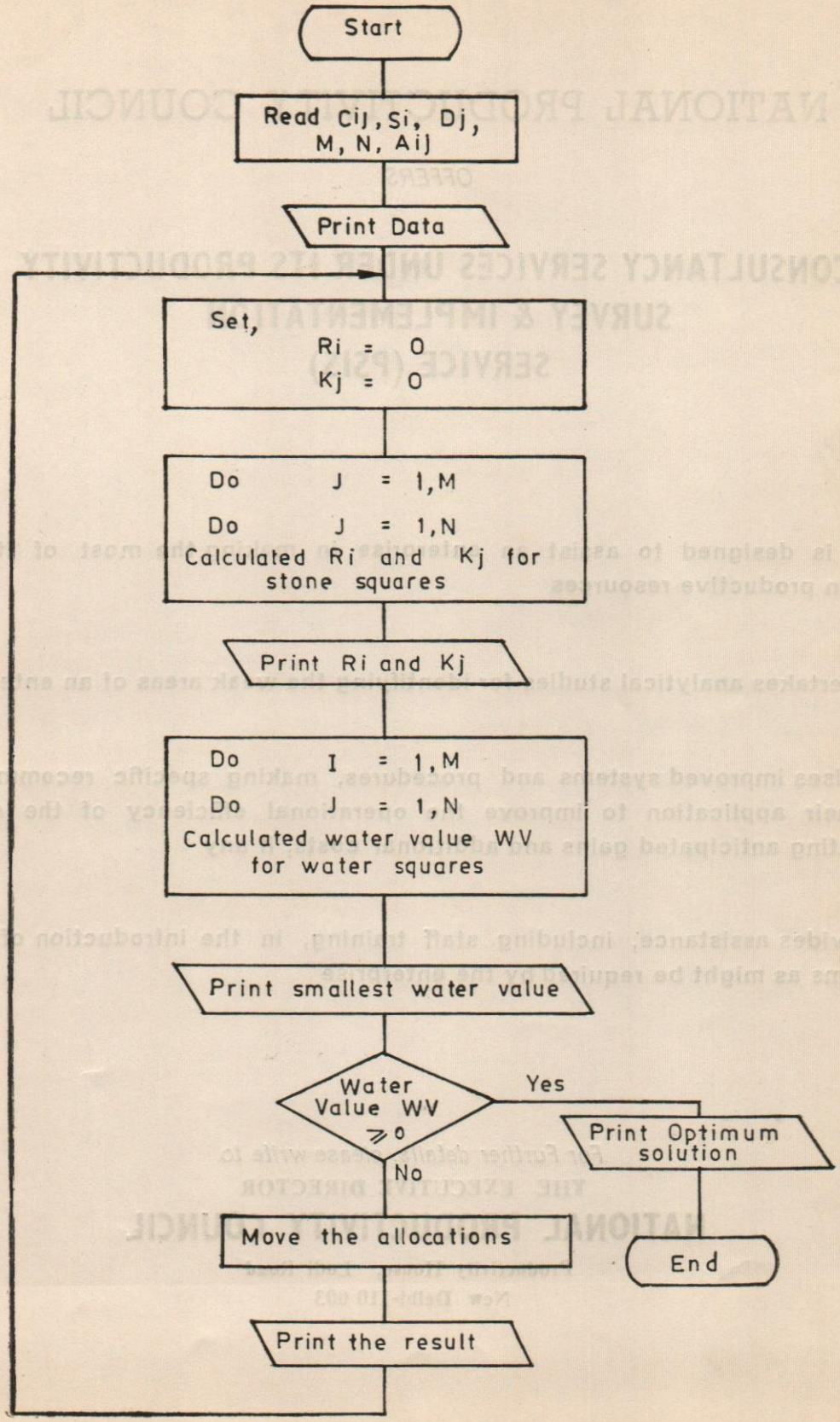

Figure 2 : Flow Chart For The Program Optroute

Productivity
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Working Conditions of Women, Young Workers, Older Workers and Other Special Categories

PROF. R. CHAMPAKALAKSHMI
Institute of Applied Manpower Research, New Delhi

For a long time women have worked under poor conditions. The less productive workers have been bunched along with them. Over the last century, some goodhearted men and women have been fighting to improve the working conditions of women and their compatriots. From time to time some legislative measures have been passed. But the feed-back on the implementation of the laws has been poor. It has been easy to blame poverty and illiteracy for tardy implementation. In India, a small group of women in the services have been able to improve their working conditions through sustained fight for justice. Several research studies at individual and institutional levels have presented the poor, less human working conditions of these employees.

The Almighty assumed the manifestation of Ardhanarishwaran, to assure that men and women are provided equal status. But alas, that was not to be ! For Manu decried thus ;

She should do nothing independently ;
even in her own house ;
in childhood, subject to her father ;
in youth to her husband ;
and when her husband is dead to her sons ;
she should never enjoy independence.

So it has been in practice, for several centuries and in all countries, without exception. From earliest times, all the world over women sowed and tilled and harvested alongside their men-poorly paid, hard working, sincere and dedicated. Inspite of many brilliant examples in the past it would be true to say that the position of women in India for many hundreds of years has not been a good one in law or in public life. Considered a liability, weak and second class citizens, the working condition of women has been — and continues to be — the nth class and worse. For over a century now, attempts have been made to improve the working condition of women, younger and handicapped workers. Legislative measures are being promulgated to improve their working conditions. These measures are, however, being more honoured in their breach. Law is one thing, the implementation of the law — in word and spirit — is yet another. Man, in the process of implementing the law introduced, exploits both the strengths and weaknesses of the law and women, children and older

workers. The only alternative available to women is to help themselves. It is unlikely that better conditions will be best owed on them for the asking. Further, women are fettered by a world-wide and deep-rooted belief in their own natural inferiority. Forming half the population of the world, they have to shake off this assumed feeling of inferiority, unite and fight for better working conditions. Success is bound to be theirs. With them they can carry the child, older and other categories of workers.

For the past 30 years, since independence, women have been discriminated against, *because women are women ;* marriage and pregnancy often debarred them from service. There was a time when the air hostesses were not even permitted to marry and had to retire at the age of 30. In the early years of independence, women in the Indian Administrative Services were not allowed to marry, they resigned to marry. Relaxations were made only after women fought for their rights. The majority of the working women are in rural India and have hardly the time to think of their rights, nor the time to think of their miserable working conditions. It would suffice to say that even economists are yet to seriously take account of women's economic contribution to the GNP or labour force participation.

A survey of employers' attitudes towards women employees affords an insight into the working conditions the employers are willing to offer women. This survey covered about 50 industrial establishments located in 7 cities in different parts of the country. The establishments covered were drawn both from the public and private sectors. Employers felt that lack of education and training for women employees were no disadvantage to work ; employers explained that women were engaged in work requiring tedious and repetitive assembly tasks with no need for theoretical knowledge, education and training. Some explicitly stated that uneducated women were more docile, could be paid low wages, had little job mobility resulting in a low labour turn-over. Statistics have also proved the point ; Assam and Andhra Pradesh with low female literacy levels have comparatively large female labour forces. This was accounted for by the traditional practice of employing female labour in the agro-industries. Employers were equally happy with the non-participation of women in trade union activities. Employers felt assured that even when women occasionally did take part, they were so few so that their interests passed inadequately represented. A report on the status of women in public sector industries, published by the Indian Council of Social Science Research in 1979, also confirms this fact. Domestic chores and family obligations come in the way of women participating extensively in unions, accounting for their weak bargaining power.

Protective legislations, which aim at improving the conditions of working women, have had adverse effects on their employment. Employers argued that administrative overhead costs incurred in granting maternity leave, the disruption of production caused by the necessity to provide substitute workers and other associated problems are disincentives to the employment of women. Absenteeism was also held against women; to the employers, the women worker absents herself when she or any other member of her family is sick; whereas the male employee absents himself only when *he* is sick. Other welfare requirements such as provision of separate dining areas, toilet facilities and creches are also considered disincentives for their employment. The employers conveniently employ a lesser number of women workers so that the legal regulations do not become binding on them. This is in total disregard to the poor conditions they afford the women presently on their pay rolls. The Committee on the Status of Women in India (1974) reported that legislative ban on work in night shifts for women also had proved to be disincentive for the employment of women. The multiple shift system practised (or being introduced) by organised industries has necessitated the need for a change in this regulation. This Committee has now recommended the need for extending the hours of work of women upto 22. Organised employment in India covers 202.07 lakh workers; of these 24 lakhs are women employees. It is their working conditions that have been briefly presented in this paragraph.

Measures to improve the working conditions and prevent exploitation of women workers by employers, are conspicuous features of labour legislation in all countries of the world, including India. The main inspiration for such protective legislation has been provided on the basis formulated by the International Labour Organisation since 1919. The legislations deal with employment

of women in unduly hazardous or unhealthy occupations, performance of duties by night, provision of maternity leave, restrictions on loads to be lifted, underground work in mines, etc. In India, these legal provisions are contained in the following Acts :-

Factories Act, 1948;

Mines Act, 1952;

Plantations Labour Act, 1951;

Maternity benefits Act (Both at the Centre and State levels) 1951;

The Indian Merchant Shipping Act; and

Equal Remuneration Act, 1976.

(i) *Hours of work :*—Under the Mines and Factory Act, women can work only for 9 hours per day with a rest interval of ½ hour after 5 hours of work. The Mines Act prohibits the employment of women underground. The Plantation Act does not provide for limits on daily work, but lays down a maximum of 54 hours of work per week. For the domestic servants and agricultural women labour there is no specific Act regulating their hours of work, etc. All the acts prohibit night work for women. The central government allows the state governments to make any relaxation necessary on the condition that women do not work between 10.00 P.M. and 5.00 A.M. If need be, the state governments can provide relaxation for women workers with central government permission.

(ii) *Leave and Holidays :*—The state government of Bombay in 1929 passed the Maternity Benefit Act. Since health and medical care are state subjects, enactment of maternity benefit legislations were done by the state at the suggestion of the Royal Commission on Labour, 1929. The Employees State Insurance Act, 1948 provides for periodical payments in case of childbirth and other associated sicknesses in cases of insured women.

(iii) *Health, Safety and Welfare Measures :*—The Factories Act prohibits the employment of women in dangerous and heavy operations. Women are also prohibited from working on cotton pressing in which a cotton opener is at work. Women are also prohibited from carrying excessive weights. Latrines, urinals, washing facilities, baths, are provided by the Coal Mines (Pithead) Bath Rules. Factories wherein more than 50 women are employed are legally bound to provide creches for children and at least half a pint of milk and 2 wholesome refreshments per day per child. A number of labour welfare centres are run by most of the state governments and union territories. These welfare centres also train women in various crafts, such as tailoring, embroidery, knitting, handicrafts, etc.

(b) The Acts are laden with all the good intentions ; in practice they leave much to be desired. This truth is brought out by a survey conducted by the Labour Bureau.

The survey of the Socio-Economic Conditions of Women Workers in Mines, 1978 states,"...elaborate legislative measures for regulating the conditions of work, ensuring provisions of welfare and protecting women from health hazards and economic exploitation were introduced mainly after independence. However, not much stress seems to have been paid to the effective implementation of these protective legislative provisions, with the result that there is still a wide gap between legal provisions made and facilities actually available. Other special programmes and measures introduced from time to time for removing wide spread illiteracy among women and improving their status have not made much impact in the rural areas. Efforts for tackling numerous complex problems have been handicapped by absence of reliable statistical and other information relating to their economic living and social conditions".

According to the survey, a large number of sample units did not comply with the statutory provision of arrangements of separate latrines and urinals for women. Existing latrines and urinals in most of the units were not in sanitary conditions and had poor arrangements for supply of water. Only a third of the collieres provided pithead baths and in most of these units arrangements for supply of water was not satisfactory.

(c) Restrictions on weights to be transported by women stood violated due to lack of specificity and required to be amended. The study also revealed that women had no possibility at all, of being promoted from unskilled to semi-skilled and supervisory jobs. The employers mentioned that women workers were not suitable for supervisory capacity; they made no attempts to provide training to women employees in order

that they may one day become supervisors. Cost of providing extra welfare amenities like creches, maternity benefits, toilets and other welfare provisions to women workers were found to be very low, costing .02 to 1.08 per cent of the total wage bill. Even so, most of the employers were reluctant to incur this small expenditure. On the other hand, some of the larger establishments were finding various methods to reduce women employment. Coal India had evolved a scheme whereby they were willing to employ male workers in replacement of women workers who were willing to retire voluntarily.

(d) Special mention has been made of the status of creches; the survey has pointed out that only 50% of the mines statutorily obliged to provide creches were found actually providing this facility. Even these creches were found to be in a state of neglect : soap and towels were conspicuous by their absence, children were fed with milk only once a day instead of being provided with three feeds as per rule. The creches were managed by unqualfied midwives and inadequately staffed. Consequently, utilisation rate of creches was as low as 7.2%. A medical bonus of Rs. 25/- formed a part of the maternity benefits. This sum of Rs. 25/- was fixed in 1951 and remains unchanged despite increases in the prices of medicines over the years. Dispensaries were under the charge of male doctors and women employees were unwilling to consult them. Thus, although the mines had provided medical facilities for women they were unable to utilise it. Such situations pass unnoticed by the management of the mines. The survey of working conditions of women in plantations have an equally sorry tale to tell. In the cashew and coir industry also, the working conditions of women are far below human.

Closely akin to the working conditions of women are those of their children. The working conditions of 52 million young children have, in recent years, evoked deep concern in people who view the young child as 'future man'. In the Indian context, children have worked and are working for their survival, much to the detriment of their physical and mental health ; their focus on work is to escape the pangs of hunger. This factor, coupled with their abundant supply has given opportunity to their being exploited. Child labour has been a global phenomenon for centuries. Literature is agog with bitter stories of this reality. With the passage of time, developed countries have almost rid themselves of this scourge. The developing countries continue to be plagued by this dread disease of child labour. In India efforts have been made over the last century to improve working conditions of children. There being no voluntary gesture from employers to *treat children as children*, nor *others, children as their children*, legal efforts have been initiated at governmental level. The first Act— Indian Factory Act, was passad in 1881. Since then, we have had several enactments, amendments and additions. Today, we have in force the following legal provisions :—

i) Factories Act, 1948.

ii) Mines Act, 1952.

iii) The Plantation Labour Act, 1951.

iv) The Merchant Shipping Act, 1968.

v) Dock Workers' Regulation and Employment Act, 1948.

vi) The Motor Tranport Works Act, 1961.

vii) The Children (Pledging of Labour) Act, 1933.

viii) Employment of Children Act, 1938. (Carpet weaving, cement manufacturing, dyers, match manufacturers, explosives, etc.)

ix) Apprentices Act, 1961.

x) The Bidi and Cigar Workers (Conditions of Employment Act), 1966.

xi) The Contract Labour (Regulation and Abolition) Act, 1970.

xii) Radiation Protection Rules — 1971— under the Atomic Energy Act, 1962, and

xiii) Shops and Commercial Establishment Act.

Some of the Acts are applicable to all states, and some are applicable in certain sector of the industry. In addition to these, the state governments have evolved their own Acts. These Acts define the areas of operation of the enactment, the nature of hazards, stipulate the age of employment, and sequence of working hours, time for commencement of work and closing-down, weekly holidays, leave entitlement, periodic medical certification, provision of rest shelters and canteen. Statutory, provision is made for the education of the workers' child. Either all

these provisions or a combination of them is deemed to be in operation in every industry in the organized sector. In the organized sector the employers set the rules to be adhered to by the child labour force under their command.

(b) Further, Article 24 of the Indian constitution also provides that no child below the age of 14 years shall be employed to work in any factory or mine or engaged in any other hazardous employment. Article 39 (c) states that the health and strength of workers, men and women and children, are not to be abused and that citizens are not to be forced by economic necessity to enter avocations unsuited to their age or strength. Article 39 (f) proclaims that childhood and youth are to be protected against exploitation and against moral and material abandonment. India has been able to ratify six of the eighteen conventions of the International Labour Organization. Three relate to minimum age for employment, one to medical examination of young persons and the other two regarding duty at night.

(a) The International Labour Organization at a recent regional conference of the UN Economic and Social Commission for Asia and the Pacific (ESCAP), placed the count of children in the world labour force at 52 million : Asia having 38 million, with India having a third of the Asian child labour force and a fourth of the world's working children. The 1971 census an earlier document—estimated the child workers at a slightly lower figure-10 million. The chiid labour force in India seems to be on the increase. This represents 4.66% of the total labour force in India. The occupation-wise distribution of child labour is indicated below : –

Area of activity	*% engaged*
i. cultivation	36.03
ii. agricultural labour	42.70
iii. livestock, forestry, fishing, plantation	8.24
iv. mining, quarrying	0.22
v. manufacturing, processing servicing & repairs	6.08
vi. construction	0.54
vii. trade and commerce	1.95
viii. transport, storage and commercial	0.39
ix. others	3.75
	100.00

78.33% of child labour is concentrated in cultivation and agriculture. Children from agricultural labour house-holds work 280 days per year on an average and those from rural labour house-holds for 267 days. The duration of wage-employment in agriculture as child labour was 207 days in agricultural operations and 17 in non-agricultural operations. Children were employed in diverse agricultural activities such as ploughing, sowing, transplanting, weeding, harvesting, etc. The average daily earnings of a child agricultural labourer for different operations vary from 71 to 90 paise. Among labourers and small farmers, 21% of the children report for work, while among the prosperous group of cultivators the percentage of child labour is negligible. The children sweat away their tender years in hard labour for small wages only to supplement the meagre income of the chronically poverty-striken rural house-holds. Their hours of labour are decided by the sun ; they work from sun-rise to sun-set. Their income hardly makes for improving their living condition ; it only paves the way for another generation of child labour. The fact that education can considerably decrease child labour is borne out by the fact that Kerala with highest literacy has lowest percentage (1.4%) of children engaged as agricultural labours while Andhra with less educational level has a high percentage of child labour.

(b) Education alone cannot provide us with an answer to the elimination of child labour. In a group of villages around Trivandrum, one-third of the total labour force working on fishing operations are children between the ages of 5 and 15. Further, 54.1% of the heads of families from which the children were sponsored were themselves victims of child-employment. Tradition seems to have a strange hold on children. If the cycle is not broken, child labour is bound to persist. Child labour is offered for 40 paisa per day on an average ; work to them is no pleasure but compulsion. In many families the eldest girl child of the family keeps home to take care of the younger ones while both parents are out to earn a livelihood. The boys working at the nets earn about Rs. 2/- per day at best; thus encouraged to drop out of school for this paltry earning. In this community the emerging picture is that of an unwary child drawn irresistably early to the beach and child labour by the social undercurrent pinning him down eternally to his boat

and net as it did his fore-bearers, and without much hope of any progress and into grinding poverty which he cannot escape.

(ii) The fish peeling centres at Kerala are another area where child labour is rampant. There are about 100 peeling centres at Quilon. Children, 5-15 years of age, work for 15 hours a day at these peeling centres. The fresh fish land at 4-00 P.M. and the children continue to work from 4-00 P.M, 7-00 A.M. the following morning. Children are rewarded 50 paisa per kg. of fish peeled. Since the industry is not covered by the Factory Act, the law cannot run its course at the peeling centers.

(iii) Sivakasi is renowned for its match-box and fire-works. Researchs suggest that some 40,000 to 50,000 children, in the 5 to 14 year age group, work at these factories. One-fifth of them are said to be *just above 5 years of age.* The children are transported from neighbouring villages to the factories in jampacked buses, work from early morning to late in the night for about 15 hours per day. These children are paid at piece-rates and, therefore, the little giants work feverishly at box making, frame filling, labelling and band-role pasting, etc. Despite all their efforts, some children make just 85 paise per day while a few earn Rs. 3/-. Children fit in 2,500 splits into boxes for a payment of 13 paise ! They work under near inhuman conditions. Recently, an explosion rocked one of these units located in a shed in utter disregard of safety regulations leading to death and injury of dozens of innocent children. Inspite of such tragedies, child labour persists in the Sivakasi match factories.

(iv) If child labour in Sivakasi, located in the Southern part of India, presents a pathetic story, the scene presented by the children weaving carpets in Kashmir is an equally heartrending picture. The carpet manufactures make enormous profits-200% to 300%. They acknowledge that but for the nimble fingers of children, their operations would collapse. But, regardless of law-man made and moral—they engage thousands of children between the ages of 6 to 14 on payment of Re. 1/- to Rs. 2/- per day. These children suffer from lung diseases due to continuous exposure to wool dust arising from the looms. Working in cramped, ill-ventilated and inadequately illuminated accommodation, with no facilities for physical exercise, the children are prone to spinal disorder resulting in stunted growth. Some of the children are said to be mentally retarded due to monotony of 8 to 10 hours of work per day on the loom. 68% of the children in the State of the age-group 6-14 are out of school and consequently the high percentage of child labour available for exploitation by carpet manufacturers.

(v) In the elite urban areas child labour takes its toll. In Delhi it is estimated that the child labour force is about 20,000. Many work places are located in lanes and by-lanes in residential-cum-business areas, served by narrow and paved roads where cyclists, cycle-rickshaws, scooters, cart pullers, and pedestrians jostle with one another.

In electro-plating workshops children of a tender age undertake cleaning and other routine and repetitive tasks like polishing or mixing 'masalas' and have their bodies covered with black soot. The lighting and ventilation are just sufficient to carry on the work. Sanitation and hygiene cannot simply be thought of in such conditions. A survey suggests the occupations of child workers as follows :—

i.	Shoe repair, domestic servants, rag picking, waste collection	25%
ii.	Sales boys, hawkers, etc.	20%
iii.	Printing, composing, book binding, etc.	17%
iv.	Engineering mechanical and metal traders such as scooter repair, etc.	16.5%
v.	Tailoring, button-hole making	11.5%
vi.	Weaving, hand embroidery, meena work, etc.	10%
		100%

Now immigrants to the ciiy take up the less hygienic jobs such as shoe-shining, rag and waste collection, and domestic service. With the passage of years, these children fix themselves up in relatively better jobs. The live in slums, unable to meet even the basic human needs. Working long hours they earn Rs. 3 to 7

per day depending upon the locality. With a little for themselves the earnings are made over to the parents. 50% of the children in registered *dhabas* and 75% of those engaged in unregistered *dhabas* work for over 12 hours in violation of the law. For most of the child labour force working hours, rest intervals, and weekly-offs are not relevant for they work and live without these under inhuman conditions, earning Rs. 30 to 100 per month.

(vi) In another survey of child labour in Meghalaya, private mines are reported as having children working under inhuman conditions. They work in mines, 90 centimeters wide and one meter high where adults could only crawl. As soon as their size is no longer profitable, they are thrown on the streets. The same fate befalls children engaged in diamond cutting. These children are cast out of work with the onset of eye fatigue even before their teens due to long hours of work in poorly illuminated rooms. This occupation also provides the children with only a pittance by way of income, but an abundance by way of diseases.

(vii) In plantations, child labour manifests itself in a more serious form ; child employment is a part of the employment of the family group. Parents do the heavier duties while the children assist in plucking tea leaves, coffee berries, collecting latex on the plantation weeding, spreading fertiliser, digging drains, etc. Children between 8-14 years of age work 40 hours per week, in rough weather to earn Rs. 1.57 to Rs. 1.76 ! Their nimble fingers are acknowledged to be turning out work that none else can do ! Children under 8 years of age are not spared ; they perform duties as baby sitters for fellow workers for as little as Rs. 5 to 8 per month. The surveys indicate an increase in the number of child workers to 51,982 (6 45%) of the total plantation workers). Himachal Pradesh, however has registered child labour to the extent of 18.7%, being the highest in the country. Lack of hygienic living conditions and other human requirements pale into insignificance seen against the hours of work, remuneration and their tender age.

(viii) In 1978, the Small Industries Fair organised a seminar for children working along side their parents. They were children of parents engaged in traditional crafts—clay, wood, ivory, iron, mask-makers, painters, magicians, puppeteers and village entertainers. Twenty children between the ages of 5 to 15 were working along side their parents. The children were remarkably good craftsmen themselves, with justifiable pride in their work. If they looked like unworthy urchins, that is where the resemblance to destitute and children ended. These children were upright and self-respecting. At the seminar titled, ' I do not have time to play" twenty two children aged 5 to 14 years participated. They answered questions ;—

Q. (1) Two of you go to school ; do the rest of you want to go to school ?

A. (1) (a) "No" they said, "what is the use of school ? In our village the teacher is never there."

(b) Another child said, "School interferes with work, how can we earn if we go to school ?"

Q. (2) Do you play with school children at games like Kabadi ?

A. (2) "We play games ; but have to take care of our hands and feet. If we hurt ourselves, work suffers", etc.

This is what working children had to say about themselves. Every child showed great enthusiasm for work. They were proud to work for their parents, and willingly worked along side. Their desire for education was subject to the existing state of the educational system in village. It was not as if they were averse to education. The children were proud and willing to work for their parents. Exploitation of child labour generally occurs only when the child is required to work for wages.

The blind, deaf and dumb and the orthopaedically handicapped from the special categories of employees. The year 1981 was set aside by the United Nations as the International Year of Disable Persons. The World Health Organisation has estimated that 10% of the population in a country fall into the handicapped category. On this assumption, India has 68 million handicapped. The Lok Sabha has set up a special committee to suggest measures for improving their working conditions. In December, 1981, it was stated in the Parliament that the committee is still working on the problem. Sixteen states have provided for reservation of positions in governmental

organisations ranging from 1 to 4%, for the handicapped. There are eighteen employment exchanges and twelve vocational rehabilitation centres. Eleven rural rehabilitation extension centres have also been established ; but considering that the 80% of the people live in villages, the need for such centres is far greater. In India, the awareness that the handicapped can contribute to nation building if given an opportunity has to be created. The U.S. Department of labour has pointed out that for every 1,000 dollars invested in the rehabilitation of disabled persons they generate 35,000 dollars during the life-term of the individual. Further, in the west it is now mandatory that public buildings be so designed to provide facilities to enable the disabled to work. They have special boards to ensure that the statutory provisions are strictly adhered to. In India the major cause for disability is associated with malnutrition and poor environmental sanitation. On the one hand, a steep fall in the number of disabled can be brought about by eradication of these twin evils, on the other hand, organised social action should go in search of the handicapped and match them to jobs under good working conditions. Constant inter-action among the disabled, their employers, the engineering and the medical fraternity will greatly help create improved working conditions for the disabled. Cases in India have proved that the illiterate artisan limb maker can, in association with the medical specialist, produce aids for the disabled with indigenous material at low cost to be fitted in a matter of minutes.

Large families, poor family-health, illiteracy, poverty locational remoteness, lack of resources and low priority for enquiry into and improving the working conditions of women, children and handicapped are the basic reasons which contribute to their poor working conditions. None of these factors can be wished away, nor do they lend themselves to instant solutions. Primarily, women have no time to think of improving their conditions because their battle is against their immediate basic needs. The majority are unaware of their poor conditions. An awareness of their poor conditions has, therefore, to be created in them and for them. Thereupon, measures for improvement in their working conditions will follow like an avalanche through self-generation. This can be brought about by changing their occupational pattern. In the villages, women should either be self-employed or work in cooperative societies at home or near home with flexible working time. Part-time help should be available to them through their children. Their income from their occupations should enable them to supplement their family income. Thus women will be free from exploitation and will have improved working conditions. This situation will create in them the awareness of the poor working conditions that they have been subjected to for a long time and soon they will set about improving the existing conditions. At the same time they will have the leisure to expose themselves to education and thereby move on the road to family planning. This in turn will reduce their basic needs and enable them to focus on further improving working conditions for themselves and their children.

To the urban women also self-employment with flexible working time will be a boon. Even more than that will the introduction of discontinuous service for women ; it is a must. It should be made possible for them to work on flexible time during the child-bearing and child rearing age and go back to service thereafter. These measures will help to improve the working conditions and productivity of women, who form about half the population of India. Existing legislation for improving the working conditions of women, children and handicapped must be strictly implemented and stern action taken against defaulters ; law should no longer turn a blind eye to them. Social pressure on employers would also go a long way to improve the existing poor conditions.

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Materials Management in Hospital

Prof. R. P. SINHA
Head of the Department of Hospital Administration AIIMS, New Delhi

Uninterrupted supply of drug, surgical, general items and balanced wholesome nourished diet are of the paramount importance for effective and efficient patient care in a hospital. Due to non-availability of right supply at right place in right quantity at right price had caused lot of criticism by press and public. To manage these materials in the hospital is a difficult task for an administrator. Apart from lack of sufficient resources (money) available to meet the need of all items, the use of techniques and skill of material management has remained neglected for a long time in the hospitals. There is a vast scope for application of sceintific material management procedures in hospital supply. A smooth supply of various items required for diagnosis and treatment in-patient care area shall surely bring high standard of patient care and save a lot of valuable life and limbs.

Hospital is a complex organisation and a teaching hospital with various specialities and super specialities are still more complex.

The technical skill of the hospital staff varies from unskilled personnel to highly skilled professionals.

A hospital has to function round the clock to eliminate and alleviate human sufferings from cold conditions as well as emergencies, which if not treated on emergent basis, may result in loss of a limb or a human life.

The services provided by the hospital vary from simple housing of the patient, to highly technical, surgical and medical procedures.

With improvement of living standard of the community, and advacement in its education and better communication system, the demand for prompt medical care has increased tremendously and administrative medicine including materials management has not kept pace with it.

The stores required by the hospital may vary from simple house-keeping materials, to highly technical equipment. Fast and rapid scientific innovation bringing new equipment and technique, and medical science progressing everyday, by the time a new equipment is purchased, it becomes obsolete. Because it takes sometimes, from the time of demand to the time it is acquired.

Materials Management in Hospital

Charles E. Housley has defined materials management in hospital as "The management and control of goods, services and equipment from acquisition to disposition"[1]. Whereas Judith A Marandola has defined the materials management, when applied to nursing services as "The management and control of medical, surgical and clerical, inter-departmental services and equipment from acquisition on floor to disposition for patient care."[2]

It can be appreciated that the task of the hospital materials manager is challenging. The detailed up-to-date knowledge of all stores in a hospital is very much needed. Approximately different types of 1200 items of general stores and 200 items of linen are required in a hospital. Un-interrupted supply of all these needs to be ensured all the time, failure of which may result in loss of human life or limb.

The pay and allowances of the staff of the hospital account for 50-60% and another 20-25% of the hospital budget is spent on purchase of stores. A lot of money can be saved out of the funds spent on stores by use of Scientific Materials Management Techniques.

The materials management had remained neglected and is still being neglected in the hospitals. However, recently the hospital administrators, at least in large hospitals have started realising the importance of materials management as one of the tools of cost reduction.

Type of Hospital Stores

The hospital stores can be divided into two broad categories :-

(1) Non consumable stores—Those stores which can be used again and again.

(2) Consumable stores — Those stores which can be used only once.

Planning of Hospital Stores

The hospital stores can be planned into following units :-

(1) *Surgical Stores* : These stores can be further divided into different categories like bandages, stures, instruments, and general surgical items.

(2) *Medical & Drug Stores* : These stores can be further divided into emergency drugs, general drugs, special drugs, extra special drugs, medical gases and chemicals etc.

(3) *General Stores* : Cleaning materials, enamel wares and patients furniture etc.

(4) *Linen Stores* : Like textiles, synthetic fabrics and woollen articles etc.

(5) *Dietary Stores* : Raw materiais like vegetables and fruits, tinned items, dry rations like atta and rice etc.

(6) *Stationery Stores* : Like general items, all medical forms and papers required for medical documentation etc.

(7) *Engineering and Maintenance Stores* : Civil, Electrical, mechanical and electronic items etc.

Objective of Materials Management in Hospitals

The basic objective to be achieved is uninterrupted supply of items, in wards and departments at reasonable cost.

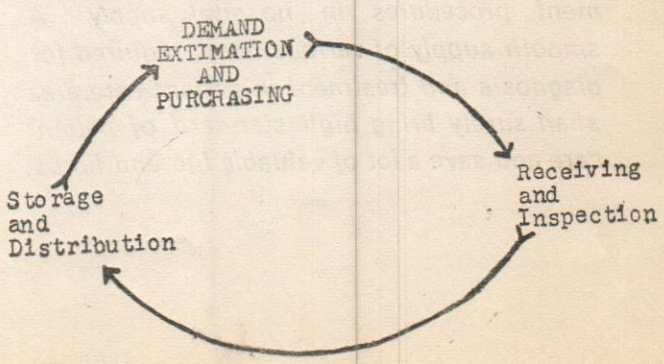
Materials Management System

Following fundamental functions of materials management can be discussed as below :

(1) Estimation of demand and purchasing.

(2) Receiving and inspection.

(3) Stores systems and distribution.



Estimation of Demand and Purchasing

The estimation or forecasting of demand is the first and the most important step. The past consumption data and any expected expansion of hospital facilities should be taken into account, while estimating the demand, but as the rates of the materials required in a hospital fluctuate tremendously, the accurate estimation of demand is very difficult.

Hospital Materials Management System

Purchasing is a basic function in materials management department of a hospital. Professional expertise is required to be exercised in this area of materials function for optimum utilisation of the scarce resources and to obtain the materials of proper quality and in proper quantity.

Methods of Purchasing

Purchasing is basically of two types :

(1) De-centralised.

(2) Centralised.

(1) *De-centralised* : The user department is responsible for purchasing. The system has got one advantage that user knows exactly, as to what is required to be purchased, but this advantage also disappears, if proper specifications of the items to be purchased are not laid down.

(2) *Centralised* : When one person or department makes purchases of all the supplies required for a hospital, it is called centralised purchasing. This method has got certain distinct advantages, as given below and should be adopted as far as possible :

(1) The technical manpower (Medical & Nursing) should be relieved of the responsibility of purchasing.

(2) The Purchase Officer to be specialised in his job, which will result in more efficient purchasing, better control on inventories and overall saving to the hospital.

The hospital may go a step further in centralised purchasing and a number of hospitals may group themselves and resort to what is known as group purchasing, which can further result in saving to the hospitals by pooling the resources at reduced direct and indirect material costs. This system is being followed by Central Government Health Scheme hospitals and Employees State Insurance Scheme Hospitals.

An efficient purchasing system can be developed in the hospitals by considering the following sub functions of purchasing : 3.

(1) Right quality.

(2) Right price.

(3) Right quantity or inventory management.

(4) Right time.

Right Quality : Quality is defined as ' fitness, merit or excellence". In purchasing, quality means items to be purchased should be able to perform the required functions at the lowest ultimate cost without sacrificing the quality. The life of the patients cannot be put to risk by sacrificing the quality of the materials for procurement at low cost.

The quality of the materials to be purchased should be described as follows :

(1) For consumable stores, ideal method is to describe the quality by chemical and physical specifications.

(2) For equipment of technical nature such as X-ray machine and laboratory equipment, the quality should be described by blue prints and performance specifications. Description of quality by brand name should be avoided as far as possible, as the branded products are usually expensive. "Sample' method of description of quality has serious draw backs as the material may be rejected or accepted by subjective judgement. Specifications of soap carbolic are given as an example below :

(1) Extra alkali contents	negligible
(2) Anhydrous soap contents	60%
(3) Moisture contents	25%
(4) Carbolic contents	5.0%

Quality control : Proper quality control is essential to maintain high standard of quality of the materials. The quality can be maintained by the following steps :

(1) The specification of materials must be described completely and clearly.

(2) The vendor must be selected carefully (see under right vendor).

(3) Inspection control—The materials received must be inspected regularly to find out if the materials, supplied confirm to the laid down specifications or not.

Standardisation

The standardisation has two aspects (1) standardisation of the purchasing procedures, which should be laid down in writing in the form of manual. (2) standardisation of the items to be purchased, which will result in reduction of variety of items to the minimum possible number. The hospitals can standardise the items and prepare a hospital formula or a manual. The standard for drugs have been laid down in Indian Pharmacopoea. The standard for most of the items of surgical stores and house-keeping materials have been developed by the Indian Standards Institution and these standards are available as priced publication for each items from Manak Bhavan, Bahadur Shah Zafar Marg, New Delhi.

It is advisable that the hospitals should have a committee to implement the standardisation programme.

Right Vendor : Selection of right vendor is an important aspect of purchasing function, which is usually ignored in the hospitals. The vendors premises must be visited by a responsible officer of the hospital to find out if the vendor possesses the required capabilities to manufacture the items being offered to the hospital. The items should be purchased directly from the manufacturers or the authorised agents as far as possible.

The vendors should be registered by the hospitals every 2 to 3 years for a specific period of time only. This should be done by inviting applications from the vendors by wide publicity through newspapers.

Competitive Bidding : This is the most commonly used method by the hospitals. The tenders are invited and the contract for supply of items is awarded to the vendor, whose bid are the lowest. However this method is successful only, if sufficient number of bidders are bidding, the size of the purchase is large and enough time is available. The Hospitals should enter into rate contracts with the vendors for a specific period of time only.

Negotiations : If for some reasons the competitive bidding is not possible, the hospital buyers may negotiate with the vendors to obtain materials at reasonable price.

Discount : The vendors may offer discounts on large quantity of materials to be purchased and also on prompt payment of bills.

Right Quantity or Inventory Management

Webster has defined inventory as "The quantity of goods or materials on hand". The inventories may lock-up major portion of the capital of a hospital. The hospital inventories in India are estimated to be worth Rs. 250 crores. So every effort should be made to reduce the inventories to the minimum possible. However, the inventories have to be maintained for smooth functioning of the hospital in continuous process of patient care.

In the hospitals the inventories consist of the following :

(1) *Central Stores :* The stores which have not been issued to the user wards and departments.

(2) *Central Pharmacy* : Those items of medical stores which are kept in the pharmacy.

(3) *Dietary Stores :* Items of food and crockery etc.

(4) *Wards and Departments :* Those items which have been issued from the cenral stores to the wards and departments.

Inventory Analysis

The hospitals should carry out the ABC Analysis of all types of stores, based on the

expected consumption of stores at lesst for one year. This will enable the hospital administrator to exercise control at proper levels in connection with procurement and consumption of items, higher annual usage in terms of costs. This analysis is required to be carried out only once in 5 to 6 years as the consumption pattern of stores does not change frequently. The information of ABC Analysis should be disseminated to the clinical and nursing staff to create cost awareness among them, about the items they demand for patient care.

From patient care point of view VED Analysis (Vital, Essential and Desirable items) is more important than ABC Analsis. The items vital for patient care (life saving drugs etc.) must be identified and their almost 100% availability to be assured all the time irrespective of the cost involved or the size of the inventories to be carried.

SDE (Scarce, difficult and easy to procure items) Analysis will help the administrators to identify the scarce items, so that proper action can be taken to procure them. If these scarce items are vital items as well, they will have to be procured from any source in any quantities and large stocks will have to be maintained.

FSNO (Fast, Slow, Non moving and Obsolete items) Analysis will help the hospital administrators in arrangement of those items in the stores room (see under stores system).

Type of Inventory Control System

The hospital administrators can choose any one of the following two types of inventory control system.

Economic Order Quantity System (EOQ)

In this system the materials are procured in predetermined economic quantity taking into consideration the different cost factors like inventory carrying costs (costs incurred on account of carrying of inventories) and ordering costs (cost per order). Larger the order quantity, higher will be the average inventories and higher will be the costs of carrying them, but lower will be the ordering costs, as lesser number of orders are required to be placed on the vendors. At particular quantity of the item to be ordered, these costs i.e. inventory carrying costs and ordering costs will be equal and the total costs (summation of these two costs) will also be the lowest, if the items are ordered in such quantities. This relationship of different cost factors is shown in Fig. 2.

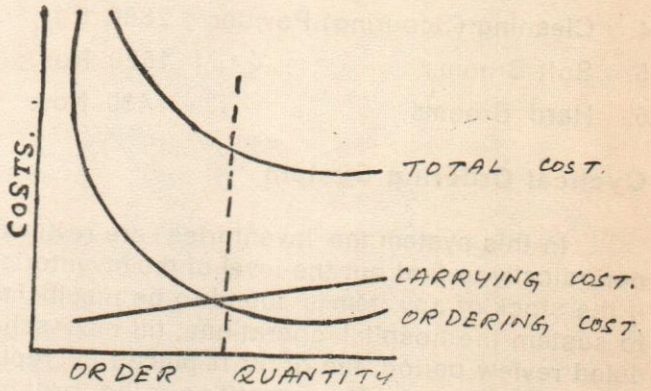


Fig. 2

This quantity of a particular item is economic quantity and to be ordered, which can be worked out with the help of the following formula :

$$EOQ = \sqrt{\frac{2\,UA}{I\,C}}$$

Where U = Expected annual usage of the item.

A = Ordering costs per order of the material.

I = Inventory carrying costs expressed as percentage of average inventory value of the material.

C = Unit cost of the items.

The items are ordered in such quantities. In this system re-order levels (the inventory levels at which the items will have to be recorded) for each items have to be worked out 4.

This system has the advantage that the inventories can be kept at optimum levels. It has the disadvantage that detailed calculations for working out the order quantities and re-order levels are required. This system can be put into operation for items, which show reasonably

stable usage rate and lead time. EOQ for general stores of a hospital of 800 beds for example are given below :

		EOQ
1.	Laundry Detergent Powder	2120 Kgs.
2.	Carbolic Soap	3390 Nos.
3.	Liquid Soap	780 Ltrs.
4.	Cleaning (Scouring) Powder	2880 Kgs.
5.	Soft Brooms	1520 Nos.
6.	Hard Brooms	410 Nos.

Cyclical Ordering System

In this system the inventories are reviewed periodically to find out the level of the inventories. If the stock of any item is found to be insufficient to sustain the hospital operations, till next scheduled review period, the order is placed to replenish the supplies. The quantities to be ordered will depend upon the usage rate of the items and review period. The suggested schedule of review of different categories of items in hospitals is as below :

A Items	— quarterly
B Items	— half yearly
C Items	— yearly

The disadvantage is that the inventories may accumulate in un-economical quantities. However, it has definite advantages in hospitals, particularly the Government hospitals, because it is very simple to operate and with the present authorisation of staff, possibly this is the only system which can be put into operation. Secondly, most of the cost factors involved in carrying or acquiring the inventories are fixed costs. Thirdly, the funds locked in inventories do not have any opportunity costs. Therefore, there is no financial advantage of keeping or acquiring the inventories in economical quantities. Govt. Hospitals can conveniently adopt the Cyclical system.

It is better to use both systems into operation for different items in the same hospital.

The order quantity of items can be worked out with the help of the formula :

(Lead time in months *Review period In months)

Average monthly consumption minus the quantities at hand at the time of review.

Safety Stock : This is the stock which is kept to cater for the variations in usage rate or lead time. The safety stock of each item should be worked out and kept separately. This stock should be turned over periodically, with the fresh stock to avoid obsolescene.

There are methods available to calculate optimum quantities of this stock. Without getting into detailed mathematical calculations, the hospital administration can keep the following quantities of safety stock of different item :

Vital Items—Quantity equal to the expected consumption during lead time.

Essential and desirable items—Quantity equal to half the expected consumption during lead time

In addition to this safety stock kept at the central stores, the wards and departments should also keep their own safety stock of at least the vital items. If the indenting periodicity of wards and departments is monthly, stock equal to the expected consumption in 15 days is adequate.

The safety stock of items of general stores was worked out and safety stocks of a few items are given as below, of a hospital of 800 beds as example : 5.

Laundry Detergent Powder	2034 Kgs.
Soft Soap	1242 Kgs,
Soft Brooms	321 Nos.
Hard Brooms	460 Nos.

Re-order level (Level at which order is to be placed)

Re-order in EOQ system of the items can be worked out by using the formula :

Re-order level — Safety Stock + expected consumption during lead time.

An example of re-order level is given as below :

(1)	Inj Insulin plain	190 Nos.
(2)	Inj. Efcorlin I.V. Soluble	257 Nos.

(3) Inj. Baralgan	366 Nos.
(4) Inj. Reverin I.V.	409 Nos.

Receiving : Receiving is often neglected in the hospitals. Receiving should not be taken lightly, as at this stage the hospital accepts the legal responsibility for receipt of materials for their correctness of quality and quantity. The receipt report or inspection report which is prepared at this stage may become the authorised document for making payments to the vendors.

The inspection must be rigidly enforced to ensure correct quality and quantity.

Identification of materials at this stage may pose a problem. To obviate this, 'codification' of the items should be adopted. Only generic names should be used for codificatton. In the hospitals memonic system of codification, is preferable which combines numeric and alphabetical notations in its symbols. This system makes the identification easier as the symbols are more descriptive. Following examples will illustrate the point.

A	01	0010
General Category Surgical	Sub Category Syringe	Specific items Type of syringe
B	01	0010
General Category Medical Stores	Sub Category Injections	Specific items Particular types of injection.

Store system : The materials should be kept in closed area and should be kept locked. The material should enter and leave the store room only when authorised by a competent authority in writing.

Physical inventory varification should be carried out at least once a year. It is advisable to carry out surprise stock verification of few potentialiality pilferable items, every now and then. The hospitals usually carry out stock verification by annual inventory method usually at the close of the financial year. The continuous inventory method (the inventories are divided into 12 equal parts and one part checked every month) has got the advantage that store room operations are not required to be shut down during the stock verification. It is useful to adopt continuous inventory method.

The store room should be located near the hospital, however, it should be easily approachable to maintain road.

Physical Facilities : The building can be of low cost type with a height of about 5 meters. The floor should be pucca and hard. Adequate shelfing facilities should be available. Space should be sufficient to accomodate the materials.

Special Feature : Certain items require special storage facilities like cold storage.

Biological items are one of them. Bonded drugs are required to be kept in secure place, under lock and key. Inflammable materials are required to be kept on sand, away from the other stores.

A large number of items in hospital has short shelf life. The obsolescence of ttems may occur, if these items are not stored by 'First in-First out' technique. The items are always issued from one end of the shelf and the new items are kept on the other end of the shelf.

The item should be issued in convenient units like in meter, Kg., liters etc. and the inventory records should be maintained in these units.

Layout : The lay out of the stores should be such that there is straight line flow of activities. Items which are issued more frequently should be kept near the issuing window to reduce the travel time of the stores personnel.

A store room location address system consisting of floor plant and stores location index is of great help to the Storekeeper in keeping the items at a particular place and locating such items.

Distribution of Stores : A Centralised distribution system of all the stores should be adopted for which Stores Officer should be made responsible. A number of methods can be adopted. One of the easiest to operate and introduce, without much financial outlay is called Fixed Shelf System. In this system a master cart carries all types of supplies from the Central Stores to all user wards and departments on fixed days and delivers a predetermined fixed quota of stores without any prior indent. The receipt for the

stores is obtained from the users. In case any ward and department runs out of stock of any of the items, such ward and department is allowed to draw the stores from the Central Stores. This system saves the nurses time spent on non-nursing duties reduces paper work, saves man power and places the responsibility of distribution of stores on stores department.

Security of Stores : As most of the hospital stores are costly and not very bulky, this makes these stores potentially pilferable. Adequate security measures should be taken to avoid loss due to pilferage and theft. Sufficient fire fighting equipment should be located in the stores area and the equipment should be tested at least quarterly. Main switch of the store room area should be outside this area, so that the electricity can be easily switched off in case of fire. The manufacturers should be requested to print the name of the hospital on the items, or the items should be stamped with the hospital stamp. Gate pass system for taking the stores out of the hospital should be introduced. A guard should be posted after working hours to guard the stores. The stores area should be adequately lit at night. Costly items may be insured. Employees leaving the hospital permanently should be asked to take clearance from the store officer.

Records : Most of the hospitals follow the lod ledger system of maintaining the inventory records. Cardex system has definite advantage over the ledger system and should be introduced in the hospitals. Cardex system is particularly useful for maintaining proper inventory control.

Disposal of Surplus : Materials may become surplus as scrap after condemnation or due to obsolescence damage or deterioration. Such material can be disposed of as under in order of preferance (1) circulate within the hospital if needed by some other ward and departments (ii) return to the vendor, if the vendor is willing to accept (iii) sell to other hospitals (iv) sell to scrap dealer (v) sell to hospital employees (vi) destroy.

Conclusion

Constant flow of the items required for the patient care can only be maintained, if the modern method of materials management are adopted by the hospital administrators. The known techniques such as economic order quantity concept, statistical quality control and operational research should be used to maintain the quality of the items at reasonable costs.

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Management Development Programmes In Windward Islands

Dr. M. YOGA
Regional Director, National Productivity Council, Bangalore

This article points out the lag of management education in the Caribbean region and details the steps that countries in the Region are taking to remedy this with the assistance of international agencies like ILO.

A. Background

1. Management education is beginning to be recognised as a significant common factor for achieving higher productivity in agricultural, commercial and industrial sectors. Upgrading of managerial effectiveness involves techno-managerial training of all managers and supervisors. While the initiative for making continual improvements and achieving higher targets is normally expected from managements, the actual achievement level is dependent upon a number of factors with labour being a key element. Hence the great emphasis on management training. And yet, it is not uncommon to find that in some countries management education lags behind worker education. This was found to be the case in Windward Islands. However, it was recognised by concerned organisations and these were willing to channel resources for management development programmes.

2. A few countries in the Caribbean region have esteblished management training institutions and these have achieved considerable progress in developing expertise, training materials, aids and services. In fact some very progressive commercial/industrial organisations in these countries are conducting in-company programmes for all their managers and supervisors. The effectiveness of these programmes are reviewed periodically and improvements made. At the other extreme are countries which are not likely to establish any management training institution in the near future. Whatever training is carried out, is done on an ad hoc basis, with no other related

services such as management consulting. Work environments and managerial effectiveness in countries of the region vary widely and mutual communication/co-operation concerning management development is minimal. It is increasingly being recognised that resoures are available within the region to put on training programmes for managers and supevisors. These countries which do not have their own institutional facilities – such as Windward group of islands can get help from within the region.

3. It was in this context what the Caribbean Management Development Service (CMDS) was established in 1975, with Caribbean Development Bank (CDB) as the Co-ordinating agency for the region, following mutual consultations among representatives of industrial/commercial organisations and management training intitutions. The key role of CMDS was to develop self-reliance through technical co-operation among the countries/organisations in the region. The scope of its activities included regional conferences, training programmes, instructor training, research, consulting, channelling of foreign technical assistance. All of these activities were to be looked after by a group of co-ordinators, one for each country and a regional co-ordinator, all of whom could devote part-time effort. All the co-ordinaters held their own full-time positions of importance in various organisations located in the region. However, there was no formal organisation structure with full-time positions and no specific financial allocations for carrying out the co-ordination work, since it was not considered necessary at that time. At this point of time a formal structure and specific financial allocations are necessary to ensure a steady flow of activities in the field of management development.

4. The basic operation involved was to start a flow of expertise and materials from advanced institutions/countries to organisations/countries who had no such resources, but needed them. In line with the co-operative approach to management development in the region, CMDS entrusted Management Development Centre of Trinidad and Tobago with the task of carrying out surveys of training needs in Windward Islands—Grenada, St. Vincent, St. Lucia and Dominica. The survey reports were completed in 1977. They included analysis of training needs, design of recommended rtaining programmes, compilation of a register of resource persons locally available and identification of institutional facilities for holding seminars/training programmes. On the whole it was commendable and useful exercise since these surveys achieved in practical terms the objectives of CMDS in a selected geographical area. Management Development Centre of Trinidad and Tobago, Management Consultants Ltd. of Dominica and University of the West Indies conducted specially designed programmes for different groups such as Boxing Plant Supervisors, Personnel Managers and Retail sales-persons. These examples are indicative of the expertise, training materials, aids and facilities available, which can be mobilised with sound planning and commensurate efforts. However, the initial spurt of activity did not continue and further, the infrastructure for maintaining steady flow of training/consulting services have not developed in the countries of Windward group.

B. Current Activities

1. The ILO Caribbean Office made available the services of a regional expert in management development for launching field advisory services in Windward Islands, under the sponsorship of Caribbean Employers' Confederation and Employers Federation in Grenada, St Vincent, St. Lucia and Domminica. Preliminary surveys in these countries revealed that in each country the size of managerial and supervisory group is between 1500-2000, with an estimated turn-over/entry figure of 3%. Most of the managerial personnel have had no systematic training in management and they were willing to join management development programmes. Extensive discussions were held with potential trainees, top managements and trade unions representatives to evolve the design of programmes. Four executive development programmes for middle managers and three top management seminars were scheduled for 1979 and they are in progress. Special efforts are being made to identify expertise/experience locally available and enlist their co-operation in conducting the programmes. The employers federation of the country being the chief sponsor of management training, it is hoped that the federation will develop a training/consulting section within its structure. However, there are problems which need to be solved and conditions to be created to develop an on-going management services centre in each of the four countries.

2. A significant event in the field of manage-

ment development was the Caribbean Employer's Workshop on Policies, Structures and Programmes for Small Enterprises Development held in Grenada during January 1979, in which delegates from 14 countries participated. A follow-up is scheduled to assess the impact of the workshop and also explore scope for further assistance wherever possible. Most of the plantations, commercial firms and industrial units come under the category of Small Enterprise, whose prosperity can be facilitated by well designed techno-managerial services. Special schemes for aiding small units are already in operation in some of the Caribbean countries, though there is scope for expansion as well as for improving quality of services.

Recommendations

1. There is considerable scope for improving the productivity in plantations, commercial firms and industrial units through application of effective management techniques. Training programmes and consulting services render aid to managers and supervisors in their efforts to improve production/performance. Such services should be made available at reasonable cost and in adequate measures by stationing a trainer/consultant in each country of Windward group. In view of the role and initiative of Employees Federations in organising management development programmes, the trainer/consultant should be attached to the local federation.

2. A team of 5 professionals with expertise/ experience in industrial engineering, financial analysis, distribution management, personnel management/industrial relations and productivity measurement is required to co-ordinate and support management development activities in Caribbean in region. This management services team should be attached to CARICOM/CMDS with responsibility to stimulate and maintain technical co-operation on an increasing scale among Member Countries. The plans, activities and evaluation of this management services team need to be evolved taking into consideration the requirements of client organisations member countries.

3. Establishment of management services section at CARICOM and stationing of trainer consultant in individual country should be planned as a 3 year project. The funding of the project should be shared by host countries, CARICOM and International Aid Organisations. It is desirable that a detailed project study is made to endorse the basic proposal.

4. The tasks assigned to the management services team of CMDS and individual trainers consultants working in each country, should include not only co-ordination of activities of other institution/countries, but also development of programmes, training materials, case studies, audio-visual aids and service manuals. These tangibles would be made available to all Member Countries. Further, the focus of the mangement services team should be on techniques for higher productivity, cost controls and waste reduction.

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For Registration and Enquiries

Please Write to :

Deputy Executive Director (Management Services)

National Productivity Council
"Productivity House"
Lodi Road
New Delhi-110 003

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Water Use and Management— An Illustration From A Command Area

M. VENKATA REDDY
Institute for Social and Economic Change, Bangalore

The benefits of irrigation would be determined, to a larger extent, by the judicious use of water for crops. In order to avoid deleterious effects of irrigation and increase its positive gains, a host of other activities would have to be initiated simultaneously with construction of canals. They include systematic land development, scientific water management, suitable crop patterns, timely and adequate input supply and motivation of farmers to take to irrigated agriculture. These are difficult tasks and may lead to the generation of varied issues and problems in command area development. Any difference in approach may aggravate the socio-economic inequalities among the rural communities. While agricultural production is important, the need for equitable distribution of irrigation benefits calls for problem-specific agalitarian development strategy.

I

The rate of growth of agricultural production in India depends a great deal on the progressive increase in irrigation potential. Extensive cultivation may not, however, be an answer to meet the growing needs of consumption of ever-increasing population on the one hand and raw material for industrial production on the other, as land is the most scarce factor of production. Irrigation is an essential factor for increasing the crop intensity and thus meeting the demand for food and raw materials.

Till recently irrigation was considered synonymous with construction of dams and canals and distributing water to as large an area as possible. With the shift from protective to productive irrigation, the need for deriving optimum out-put per unit of water has become important. Water is a scarce and costly commodity and has to be used judiciously. Though water is a limiting factor in crop production, it is not yet considered as important an input as seed, fertiliser and pesticides. It is sometimes believed that, irrigation, if not used properly, would adversely affect food production and also lead to other undesirable conditions such as water logging, salinity, etc. This is more so in a command area where farmers are used to traditional and dry cultivation and are totally ignorant of irrigated agriculture. Thus, there is an imperative need for economic and efficient use of this scarce but valuable resource.

Objective : This paper makes an attempt to assess the problems of farmers in irrigated agriculture in general and effective use of water for crops in particular. The difficulties of farmers in developing land on a scientific lines for economic and efficient use of water are highlighted. Irrigation practices followed by cultivators and its impact on yield rates have been discussed. Farmers' involvement in voluntary organisations like irrigation committees is also focussed.

Methodology : Sample for this study[1] is drawn from Malaprabha command area in the state of Karnataka. Multi-stage sampling has been adopted for the selection of households, the stages being 1. Command 2. Taluk 3, Village and 4. Cultivator household. Three taluks in Malaprabha command have been selected on the basis of irrigation potential created. One village from each taluk was selected on the basis of geographical area, soil type, area irrigated, duration of irrigation and levels of institutional development. In all 258* cultivators have been chosen by stratified random sample method, strata being landholding size. Data are collected by personal investigation through the help of a schedule prepared for the purpose.

II

Background : The study region (Malaprabha Command Area) is a semi-arid zone in northern part of Karnataka State. The area is traditionally dry with a scanty and erratic rainfall resulting in frequent droughts. Deep black soils are ubiquitous in the command area. Water management in black soils is really a serious problem. Its magnitude in a dry zone where cultivators are not used for irrigated agricuiture needs no emphasis.

The lack of experience on the part of the farmers has made irrigation schedule rather a serious hazard, either there is too much watering too frequently or there is complete indifference. It is true that it would be difficult to maintain an ideal soil moisture level through out the season. Nevertheless, there is a need to maintain some balance to eliminate hazards of crop production due to lack of moisture. This calls for sufficient care to provide adequate water to the root zone. The research on moisture level by various soil types is in progress in the command area ; much more needs to be done and what is equally important is its adoption by the farmer.

Cropping pattern in the command area is based on light irrigation. The cultivation of heavy crops like paddy and sugarcane is not permitted. Water is released on the basis of 40 : 20 : 40 i.e., 40 per cent in Kharif season, 20 per cent bi-seasonal and 40 per cent Rabi season. Major crops grown are jowar, maize, wheat and cotton.

III

Efficient and economic use of water in the command area depends, to a large extent, on cultivators' knowledge of irrigated agriculture. Farmers should be aware of the importance of related issues, like systematic land development, soil characteristics, suggested crop pattern, water use and control methods, crop water requirements, etc. for getting optimum benefit per unit of water. An attempt is made to analyse farmers' reactions to these issues.

Land Development

Systematic land development is an essential pre-requisite for efficient water use. It is primarily meant for smooth flow of water avoiding wastage and helping uniform growth of plants through equitable distribution.

In the study region land levelling work did not keep pace with irrigation potential created. 33 per cent of sample farmers whose lands were notified for irrigation have not taken up land levelling work.

This underlines the need for educating farmers on relative advantages of land development. 48 per cent of the farmers were aware that land development facilitates smooth flow of water, avoiding wastage. The remaining 52 per cent knew that it would also help in getting higher yields through equitable distribution of water.

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* The views of cultivators who are actually using water have been considered for this paper.

However, quite a few cultivators did not take up land development work. Lack of adequate finance is the most important reason for not developing the lands. As high as 75 per cent of those who had not developed their lands reported this reason. This empirical observation suggests strengthening of credit flow to farmers to take up land levelling work.

Soil Testing

Cultivators should know the characteristics of soil to use water economically and efficiently. Soil testing would help farmers to understand the nature of their lands and plan the crop pattern, water requirements and fertiliser use. It appears that the importance of soil testing has progressively been realised by cultivators.

In 1974 hardly 7% of sample cultivators had got their soil tested. This percentage increased to 18 in 1975 and to 41 in 1976. In 1977 this had declined to 5%. However, 4% of sample cultivators told that every year soils are tested. On the other hand, 25% of sample cultivators had not tested the soils. The extension agents should impress upon the cultivators the importance of soil testing for profitable use of their lands. A net-work of soil testing laboratories is essential in different localities.

Crop Pattern

Majority of farmers grow crops recommended by the department of agriculture. As high as 96% of cultivators are growing crops recommended by the department (Table 1). Water Management would become easy when the farmers accept to grow crops recommended along with suggested packages of practices, including number of irrigations; while crop pattern is adopted, concomitent suggestion on water management is not.

Knowledge about Water Management

Almost all sample farmers are aware of the need for sound water management as 98% of them have expressed their desire to learn and practice it (Table 1). Further, roaster irrigation system is known about 83% of cultivators. However, the majority is of the opinion that roaster system of irrigation is not popular. Some others complained that cards are not issued and

Table 1

Cultivators response to recommended crop pattern, awareness of sound water system and Roaster System

Landholding size (Acres)	Do you grow recommended crop		Awareness of sound water system		Roaster system						Co-operation beween farmers
	Yes	No	Yes	No	Yes	No	Not working	Cards not issued	Not good	All right	
Upto 2.50	2(100)	—	2(100)	—	2(100)	—	1(50)	—	—	—	—
2.51—5.0	28(96)	1(4)	27(93)	2(7)	24(83)	5(17)	6(21)	3(10)	—	2(7)	1(3)
5.01—7.50	25(96)	1(4)	25(96)	1(4)	21(84)	5(19)	10(40)	—	1(4)	—	1(4)
7.51—10.0	21(100)	—	21(100)	—	16(76)	5(24)	7(33)	—	—	—	—
10.01+	90(94)	6(6)	94(98)	2(2)	80(83)	16(17)	51(53)	—	—	1(1)	2(2)
Total	166(96)	8(4)	169(98)	5(2)	143(83)	31(17)	75(43)	3(2)	1(1)	3(2)	4(2)

Note : Figures in brackets are percentages.

co-operation among farmers is lacking. Thus, roaster system did not have any impact on cultivators. Roaster system, if properly implemented, with appropriate regulations, would particularly solve water scarcity for tail-enders. Futher, cultivators can save a lot of time in irrigating their land if they are aware of correct timings and duration of water let out to their fields.

Water Use and Control Methods

Table-2 reveals that scientific methods are not followed by a majority of cultivators. As high as 70 per cent of the selected cultivators have adopted opencut method for releasing water into the field. Scientific methods such as pipe, gates and syphon systems are found to be in vogue in the command area. It is observed that 10% of the sample cultivators are using pipes to let water into the field; 15% release water through farm ditches, and 5% use syphon and gates systems. This would underline the importance of getting cultivators familiarised with scientific water use methods.

When once water is released into the field, the problem of controlling water supply arises. Water control is a difficult task especially in black soils where soil becomes very loose at the time of irrigation. If water flow is not controlled properly it leads to excessive water storage and concomitent bad effects on crop yield as well as soil fertility. In the command area various methods such as forming bund, keeping stones, keeping mud block, wooden pieces, and drainage etc. are used by cultivators for controlling water. Among these devices forming bund and keeping stones are found to be more in practice as 46% of the selected cultivators have used the former and 44% the latter. Other methods mentioned above are hardly used.

In view of the soil texture the most convenient, though crude or unscientific device to

Table 2

Water use and water control methods adopted by sample farmers

Landholding size (Acres)	No. of cases	Way in which water is let into the field					Method adopted to control water supply							Determining Adequacy of water	
		Open cut	through pipe	Farm Ditch	Syphon	Gates	Forming Bund	Keeping stones	By drainage	Keeping mud Block	Wooden pieces	Tailender	Gates	Observation	Soil condition
Upto 2.50	2	1 (50)	—	1 (50)	—	—	1 (50)	—	1 (50)	—	—	—	—	2 (100)	—
2.51–5.0	29	21 (72)	2 (7)	5 (17)	1 (3)	—	17 (59)	9 (31)	—	3 (10)	—	—	—	29 (100)	—
5.01–7.50	26	19 (74)	3 (11)	3 (11)	1 (4)	—	13 (50)	10 (38)	—	2 (8)	1 (4)	—	—	26 (100)	—
7.51–10.0	21	12 (57)	2 (9)	7 (34)	—	—	10 (48)	8 (37)	—	1 (5)	1 (5)	—	1 (5)	19 (95)	2 (5)
10.01+	96	69 (72)	10 (10)	10 (10)	4 (4)	3 (3)	39 (41)	49 (51)	—	1 (1)	1 (1)	1 (1)	5 (5)	92 (96)	4 (4)
Total :	174	122 (170)	17 (10)	26 (15)	6 (3)	3 (2)	80 (46)	76 (44)	1 (1)	7 (3)	3 (2)	1 (1)	6 (3)	168 (97)	6 (3)

Note : Figures in parentheses are percentages

control, would be keeping stone blocks. It can easily check the water flow. Among the scientific methods gates may be more convenient to regulate the water supply depending upon the requirement of crops. This also helps to check the erosion of soil in the channel.

In the study area only surface irrigation is commonly practised by cultivators. This is accomplished by impounding water on the soil surface so that water enters soil to proper depth and satisfies crop water needs. Further, it is uniformly distributed to all parts of the plot or field avoiding excess losses by deep percolation or by surface runoff at the end of the plot or field.

The irrigator must recognise that he has to vary or change certain practices in order to get the maximum benefit from irrigation. These practices include unit area to be irrigated, the length and time taken to cover the unit area, coustruction of distibution structure and proper land preparation to permit uniform distribution and draining excess water. Wrong methods will contribute to possible serious damage to soil by way of soil erosion, water logging and soil salinity. In the study area, the cultivator is using either too much water or too little due to lack of experience.

Irrigation Schedule and Water Requirement of Crops

Cultivator should, essentially, understand soil-plant and soil-water relationships to know water requirement of crops. It is possible then to make rational decisions about the time and amount of water application along with the type and design of irrigation methods, including other aspects of irrigation water management.

In deep black soils, it is too hazardous to be ruthless in water application. The purpose of irrigation is to provide soil moisture in adequate quantities in the immediate vicinity of the plant roots. This purpose will be defeated if the correct amount of water is not applied. Excess of water may result in salinity while insufficient water will reduce soil moisture level resulting in low yields of crops. It is necessary to avoid long term adverse consequences of indifferent irrigation. It is here that the technology of water application gains importance.

Consumptive use of water is also important. The number of days of watering should necessarily be a function of peak consumptive use[1] period of the crop. None of the farmers are aware of this. Actual practice of the cultivator is based on his own understanding of soil moisture level and crop water requirement. In the heavy soil region, it is very necessary that irrigation period is shorter.

Water use, in terms of net requirement, gross water application, irrigation frequency and period, has a considerable influence on crop yields. The impact of irrigation frequency (number of irrigations) on yield rates of four important crops namely, jowar, maize, wheat and cotton, in the command area has been tested. It is very interesting to find a highly significant relationship between yield and irrigation frequency. Table 3 reveals that a high percentage of farmers gave more number of irrigations than required and got low yields. This might have resulted in scarcity of water, mostly for tail-enders, depriving them of higher yields. The percentage of farmers who used more number of irrigations than required is 62 in the case of maize, followed by 15 in Jowar, 46 in wheat and 78 in cotton This has led to wastage of water and also low yields. Cultivators who have given insufficient number of irrigations and excess number of irrigations got invariably low yields when compared to those with optimum number of irrigations. In the case of jowar 6 irrigations have proved to be optimum while below and above that has resulted in low yield. Similarly farmers who gave 7 irrigations for maize, 6 for wheat and 8 for cotton got optimum yields. Thus, there is an imperative need to educate farmers about using optimum number of irrigations with appropriate intervals.

Further, this has been tested by fitting a second degree equation. For maize and wheat the "points of inflexion" are observed at 7 irrigations and 9 irrigations, respectively, whereas in the case of jowar this optimum point is observed at 8 irrigations. These results are almost nearer to the empirical observations presented in table 3.

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1. Consumptive use, often called evapotranspiration, includes water used by plants in transpiration and growth and that evaporation from adjacent and from precipitation.

Table 3

Irrigated frequency and crop yields

No. of irrigations	Maize		Jowar		Wheat		Cotton	
	% of farmers	yield	% of farmers	yield	% of farmers	yield	% of farmers	yield
1	—	—	4.9	1.1	1.8	0.7	4.3	1.0
2	—	—	19.5	1.9	3.6	1.0	—	—
3	1.3	2.0	7.3	2.3	—	—	—	—
4	3.9	2.1	34.1	3.3	14.3	3.0	—	—
5	9.2	5.3	7.3	4.0	12.5	4.4	4.3	3.0
6	14.5	6.4	12.2	7.4*	21.4	5.3*	—	—
7	9.2	7.5*	—	—	14.3	3.5	—	—
8	15.8	5.0	—	—	7.1	1.9	13.0	3.3*
9	1.3	6.0	—	—	—	—	—	—
10+	44.8	7.2	14.7	4.2	25.0	3.1	78.4	3.2
Total	76		41		56		23	

* highest yield with optimum number of irrigation

The equations are given below :

Maize : $Y=6.1+0.26x-0.009x^2$
at $x=7$, and $Y=7.5$

Jowar $Y= -2.90+2.19x-0.13x^2$
at $x=8$, $Y=6.3$

Wheat $Y=1.90+0.35x-0.01x^2$
at $x=8$, $Y=4.0$

Where X = number of irrigations and Y = yield per acre (in quintals)

Village outlet committees

Effective water management is possible by voluntary involvement of cultivators in distributing water among their farms. This would inculcate group functioning eliminating the present attitude of "each for himself". For this purpose it has been suggested to the cultivators to form committees for different outlets so that they can solve their problems with mutual understanding.

It is found from table 4 that 80% of cultivators are aware of the village outlet committee and only 20% have no idea about its existence. However, surprisingly only 12% of the selected cultivators are members of such committees. Futher, only 51% of cultivators who are not members knew one member or the other in the committees. Thus, participation rate is quite low, though they are aware of the importance and existence of the committees. There is a need for motivating cultivators to form such voluntary organisations through which they can solve their problems. Their dependence on outside agencies (officials connected with irrigation and agriculture) may lead to abnormal delays and loss of certain crops due to lack of timely water supply.

Usefulness of the outlet committees

Inspite of low participation of farmers the village outlet committees have made attempt to solve irrigation problems. While 42% of selected cultivators could solve their problems with the help of those committees, 44% were helpless and

Table 4

Cultivators awareness of village outlet committees—landholding size wise

Land holding size (Acres)	No. of cases	Cultivators awareness of village outlet committee		Member or not		Contact with any member in the committee		Help from outlet committee			Opinion on the village outlet committee		
		Yes	No	Yes	No	Yes	No	Yes	No	Not contacted	All right	Not working	No idea
Upto 2.50	12	1	1	1	1	—	2	1	1	—	1	1	—
		(50)	(50)	(50)	(50)		(100)	(50)	(50)		(50)	(50)	
2.51—5.0	29	21	8	6	23	10	19	8	15	6	7	15	7
		(72)	(28)	(21)	(79)	(36)	(64)	(29)	(53)	(18)	(25)	(53)	(21)
5.01—7.50	26	18	8	—	26	18	8	9	11	6	10	9	7
		(69)	(31)		(100)	(69)	(31)	(36)	(44)	(20)	(40)	(36)	(24)
7.51—10.0	21	16	5	3	18	12	9	7	8	6	6	9	6
		(76)	(24)	(14)	(86)	(57)	(43)	(33)	(38)	(29)	(29)	(43)	(29)
10.01+	96	82	14	11	85	48	48	47	41	8	48	18	30
		(85)	(15)	(11)	(89)	(50)	(50)	(49)	(43)	(8)	(50)	(19)	(31)
Total	174	138	36	21	153	88	86	72	76	26	72	52	50
		(80)	(20)	(12)	(88)	(51)	(49)	(42)	(44)	(14)	(42)	(30)	(28)

Note : figures in parentheses are percentages

remaining 14% did not contact the committee at all. If all the cultivators under one outlet could become members there would be some obligation to agree on a compromise in the common interest of all. By and large the effectiveness of such committees depends upon the interest of cultivators themselves.

The functioning of the outlet committee appears to be unsatisfactory. About 42% of cultivators are of the opinion that their performance is alright as against 30% who have complained that they are not at all working. Rest of them have no idea about the outlet committee. Thus it is evident that unless all the cultivators take keen interest in the operation of this committee it cannot function effectively. It is suggested that more representative irrigation committees with officials and non-officials and with sufficient authority and power to enforce the decisions be constituted for each distributory (outlet).

The Deliberate Breaches

The common complaint from irrigation authorities as well as cultivators is about the deliberate breaches on the conveyance system. This leads to wastage of water resulting in inadequate water supply to tail-enders. When asked for comments on breaches, only 32% of the cultivators told that it should not be done. On the other hand as high as 62% of them did not comment on the issue. This gives an impression that many people are taking water through breaches. Deterrent punishment by way of fine or if necessary, stopping of water for a season is the only alternative to prevent breaches.

Conclusions

The study based on experience in two major command areas in Karnataka focuses on a few important aspects of water management in newly irrigated areas.

Scientific water use and management is one of the problems in the command area. Traditional farmers with no experience in irrigated agriculture find it difficult to switch over to wet cultivation. They have appreciated soil-water relationship and crop-water requirements.

Land development which is primarily meant for efficient and economic use of water should be given due importance. Quite a few farmers do not level lands systematically. This leads to many problems. Lack of adequate finance is the major impedement for scientific land development. The role of land development bank should be increased in financing farmers. Legislation for compulsory land development, at least one year before the actual release of water, could be thought of as an alternative. The expenditure so incurred may be collected along with land revenue.

The need for educating farmers on periodic soil tests, recommended crop pattern and the package of practices, especially irrigation practices, is high in the command area.

The irrigation practices followed by cultivators are far from satisfactory. Either they are applying too much water or too little, which has led to lower yields. It is observed that water is flushed into plots by open cut method, which drains mostly into the adjoining plots. This will lead to serious soil erosion and also wastage of water. Provision of proper distribution boxes and drop structures at appropriate places would avoid misuse and wastage of water.

Irrigation committees are not functioning properly. Instead of irrigation committees it is better to have outlet committees. The members of this committee should be from the upper, middle and lower reaches. They should workout irrigation schedules (roaster system) so that all the cultivators within an outlet get equitable distribution without any difficulty. Any complaint from the cultivator should be decided by committee. Even the maintenance of field channel and drop structure should be the responsibility of the committee (executed under the guidance of the P.W.D.). The charges on maintenance could be collected from the cultivators.

Taking water through breaches should be discouraged. The irrigation authorities may consider delegating powers in such cases to the irrigation committee to take immediate spot action by way of fine or stopping water supply.

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Maintenance Work Measurement & Development of Maintenance Time Standards

R. M. NARCHAL
Dy. Director, National Productivity Council, New Delhi

The use of the work management technique in planning the maintenance work has been very effective in most of the cases. This ultimately helps in increased morale of the maintenance worker as well as of the manager and proves that the maintenance work can be very effectively planned and controlled. There is no alternative to it and any alternative to this can lead to idle labour, high cost, low morale and chaotic control.

As a result of rapid industrialisation, major production activities are slowly being transferred from human hands to machines and automation equipments. To increase the production at faster rate, the speeds of the moving parts in any machine or equipment are also increasing to maintain the rate of production. Due to fast speeds of the moving parts in any machine the rate of wear and tear and the rate of deterioration in any component parts of the machine is also increasing. With the rapid growth of industry and with automation increasing, the capital input in any industry is many times greater than before.

Management of capital resources has always been important and it is more so today with the increase in capital investment in industry. Maintenance management has, therefore, assumed an exceedingly important role today. It has become more essential to keep the machine in running and good condition by reducing the rate of wear and tear on the machines. Today the major objective of any maintenance function is to see that plant and equipments are maintained in a way that enables a plant to manufacture its products with the lowest unit cost consistent with the safety and well being of the workers. In correct terminology, maintenance management seeks to maintain plant and equipment in a way that optimises its contribution to the company's overall objectives. It is often costly to over-maintain or under-maintian the plant and equipment. For carrying out the optimum maintenance in any plant, the planning of maintenance work plays a very important role. The maintenance work cycle can be constituted as given in Exhibit 1 below.

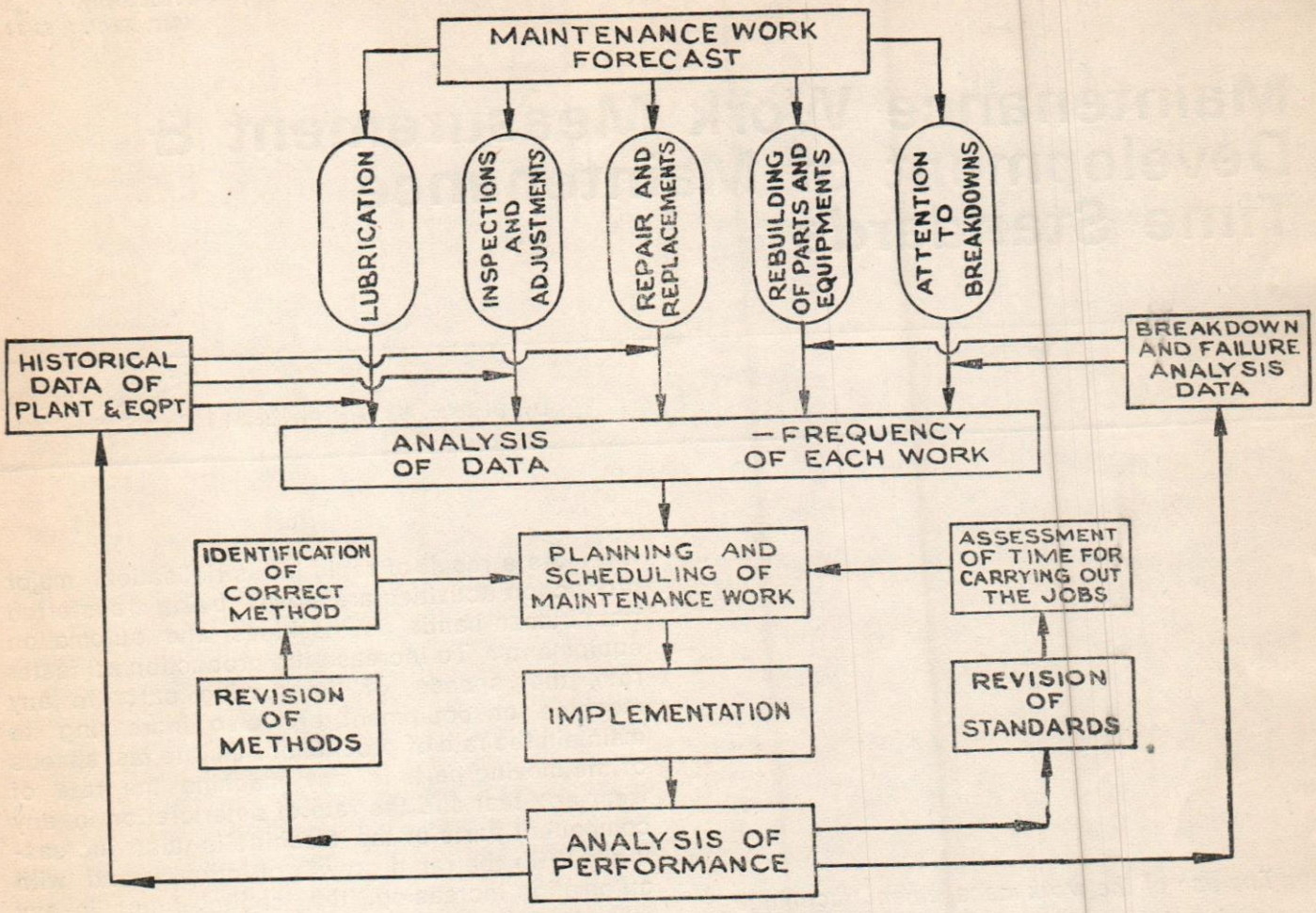

Exhibit 1 : Maintenance Management Cycle

If we analyse this work cycle for the maintenance function, it is felt that maintenance function is easily able to estimate the quantum planned and preventive maintenance work, i. e., lubrications, inspections, repairs and replacements, etc. The only criterion for this is the past data based on history of the equipment as well as its designed specifications for maintenance. The breakdown work can also be estimated based on the failure analysis and breakdown analysis of the parts and components. The analysis of this plant maintenance data for machines and equipment leads us to the frequency of each of the maintenance work. The next step is planning and scheduling of all maintenance work. In most of the cases the maintenance manager fails in planning and scheduling of the maintenance work due to following reasons :

(i) The breakdowns are random

(ii) The time estimation for maintenance work is difficult and often fluctuates with the conditions of work

(iii) The method of carrying out the maintenance work changes with worker and with degree of deterioration.

(iv) The fluctuations in maintenance work load is high so manpower planning is difficult.

Due to the wide variations in actual time taken and planned time the motivation and morale of the maintenance workforce decreases. At the time of performance analysis for the maintenance function the maintenance workforce is not able to achieve its objectives due to break in chain link between planning and implementation stage. In case the link between planned work and its implementation is maintained by effective time assessment of each of the maintenance work, the performance of the maintenance function can be

improved in every cycle by revising the data based in feed back information received.

Need to Measure Maintenance Work

Maintenance planning is essentially carried out for achieving the maintenance objectives. It pre-supposes the establishment of quantitative goals against which the performance can be measured. For effective planning of the maintenance work the following questions must be answered.

— What work is to be done ?

— How is it to be done ?

— How long it will take to carryout the job ?

— What resources (manpower, etc.) are required ?

— By what time it must be accomplished ?

The resource requirements are then balanced against the resource availability by translating them in terms of time. The plan is then prepared against which the actual conditions would be compared. This requires measurement of maintenance work. The more accurately the measurement is done the better is the maintenance planning and control.

Maintenance work measurement offers effective means of planning and control of routine, planned and preventive maintenance activities for reducing the costs not only in terms of rupees but also in terms of mental stress, strain and frustration that a chaotic control causes. Exhibit 2 illustrates diagramatically a maintenance planning and control cycle. Indicating that the maintenance work measurement is required at the initial stage of planning to balance the manpower available with the manpower required against the target time. The need to measuring the maintenance work again arises at the time of measuring the output achieved by executing the planned work.

The maintenance work measurment also helps in :

(i) Better supervision by allowing the supervisors to control the work which has been already measured.

(ii) Identification of training needs by locating areas where the work has not been accomplished as per the measured.

(iii) Introduction of direct incentives for maintenance work force by measuring their outputs and linking it with financial incentives.

(iv) Improving the quality of work, since for measuring the work, the detailed recording and analysis of the work has to be done.

Procedure and Techniques of Measuring the Maintenance Work

Work measurement is the application of the techniques to establish the work content of the job in terms of time.

In more details, work measurement is defined as "application of the techniques designed to establish the time required to carry out a specified job by a qualified worker at a defined level of performance".

In this definition one has to be clear about following aspects :

(i) The job to be measured should be defined and specified : i. e.

—Limits of the jobs viz its starting point and completion point should be specified.

—The tools, equipment and materials for the job should be specified.

—The manpower and its qualification should be specified.

—The method of carrying out the job should be specified.

(ii) The job should be carried out by a qualified worker with necessary skill, training and experience.

(iii) The job has to be carried out at a defined speed and effectiveness to adhere to the representative method specified earlier.

Once these three points in work measurement are thoroughly understood one can look into

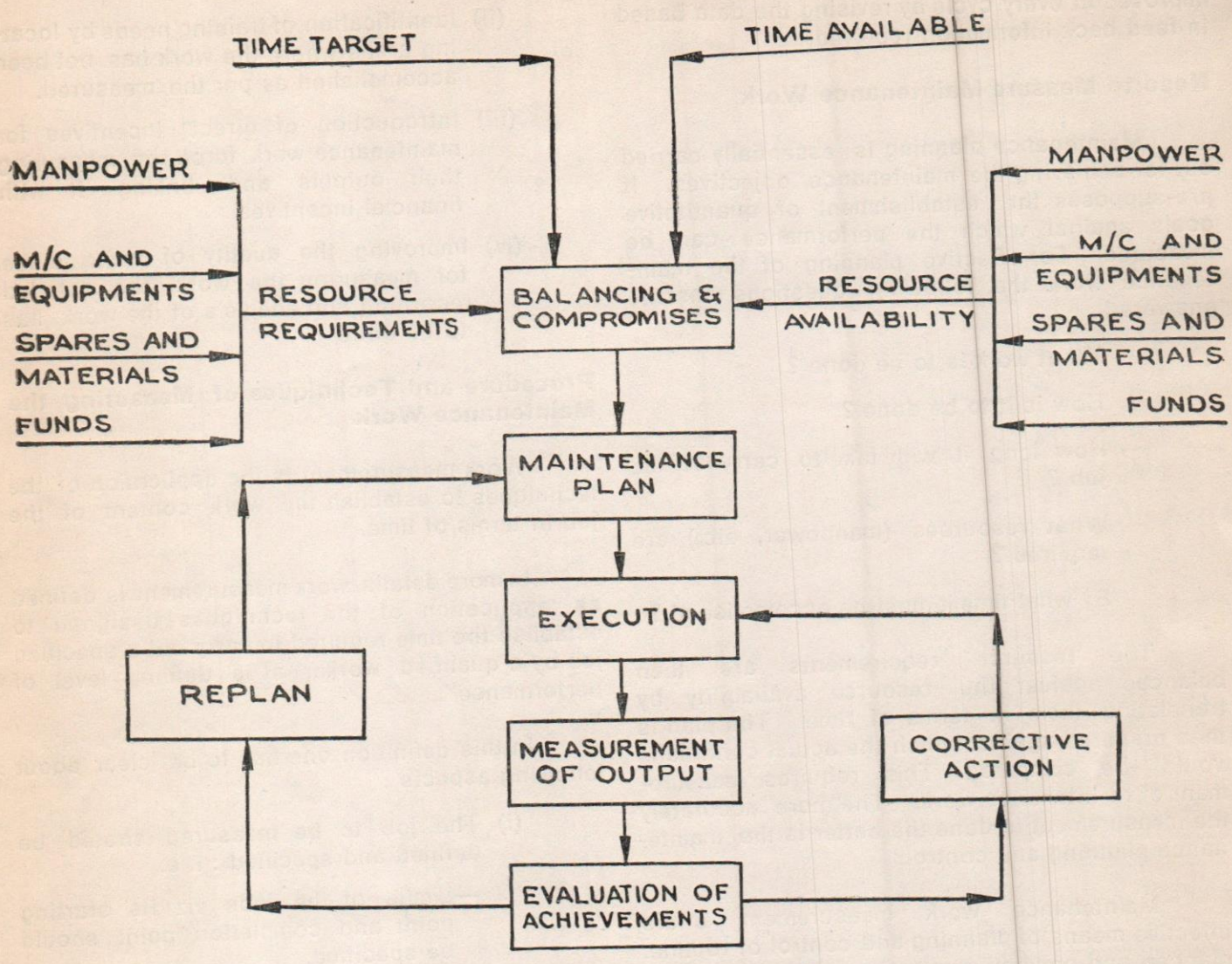

Exhibit 2 : Maintenance Planning and Control Cycle

the general procedure of work measurement in the following stages :—

1. Select the job to be measured.
2. Break the job into elements and record.
3. Examine the elements critically.
4. Measure the work in each element. (Apply work measurement techniques)
5. Compile the measured work.

Selection of the Job to be Measured

Most of the maintenance jobs are not repetitive like production jobs. Therefore the usual procedure of work measurement cannot be directly applied to the maintenance jobs. The maintenance jobs in any industry consist of following types of work :

(i) Preventive maintenance work
- —Cleaning
- —Lubrication
- —Adjustments
- —Application of Protective coatings
- —Inspections

(ii) Repair and replacement work
- —Repair of the components
- —Replacement of parts and sub-assemblies

(iii) Overhauling of machines and equipments

(iv) Installations of machines and equipment

Broadly speaking, preventive maintenace jobs are of repetitive nature, although the variety of jobs is high in case of high variety of machines and equipment in company. In most of the cases these jobs are selected for work measurement studies because of their repetitive nature. Usual work measurement techniques can be used in studying these jobs.

Repair and replacement work varies with the type of repair, replacement, and equipment on which it is carried out. Due to its high variability these jobs are measured by work measurement techniques based on estimation as well as on motion study.

The last two types of jobs are not usually selected for work measurement studies due to their low frequency and high variability. However, one can work out the time required for undertaking any overhauling job or installation job by work measurement studies carried out in case of the first two types of maintenance jobs.

Whenever a maintenance job is selected for measurement studies the following points must be noted before undertaking the studies :

(i) Purpose for studying the job

(ii) The limits of the job

(iii) Specifications of the job including the tools, equipment and materials required

(iv) Method of carrying out the job

(v) The life of the job.

These items are essentially noted down as the time for carrying out the job varies largely with reference to these items except the first and the last items. The purpose of the job indicates the accuracy required in its study and the job is not selected for study if it is not likely to continue for a long time in future.

Developing a Breakdown Structure of the Work and its Examination

Whenever any maintenance work is to be selected for any study, the work is broken down into component jobs, each job is broken into operations and operations into elements to develop a breakdown structure of the work to be studied.

The breaking of the maintenance work in this manner results in systematically listing of all elements under each operation, all operations under each job, all jobs under each task and so on. Examining each one of these helps in eliminating any amount of unwanted elements which might otherwise be carried out. This also results in standardisation of the method being adoped for any element or operation. An example of a breakdown structure of one of the maintenance works is given in Exhibit 3.

The jobs once broken down in this systematic fashion are now ready for measurement. Let us now have a glimpse of the various work measurement techniques and the use of each of these techniques in maintenance.

Techniques of work measurement used in measuring the maintenance work

The following are the work measurement techniques which are often used for measuring the maintenance work.

—Job estimating

—Statistical analysis of past records

—Time study

—Production study

—Analytical estimation

—Work sampling

—Standard data

—MTM/PMTS

Some of these techniques are very accurate but have limited use in maintenance. However, the others may not be so accurate but have high utility value for maintenance jobs.

Job Estimating

This is the crudest method of establishing the time that should be allowed for a given job. In this the Supervisor/Foreman estimates the time for the job based on his experience. Estimates of the time required in this manner by an individual

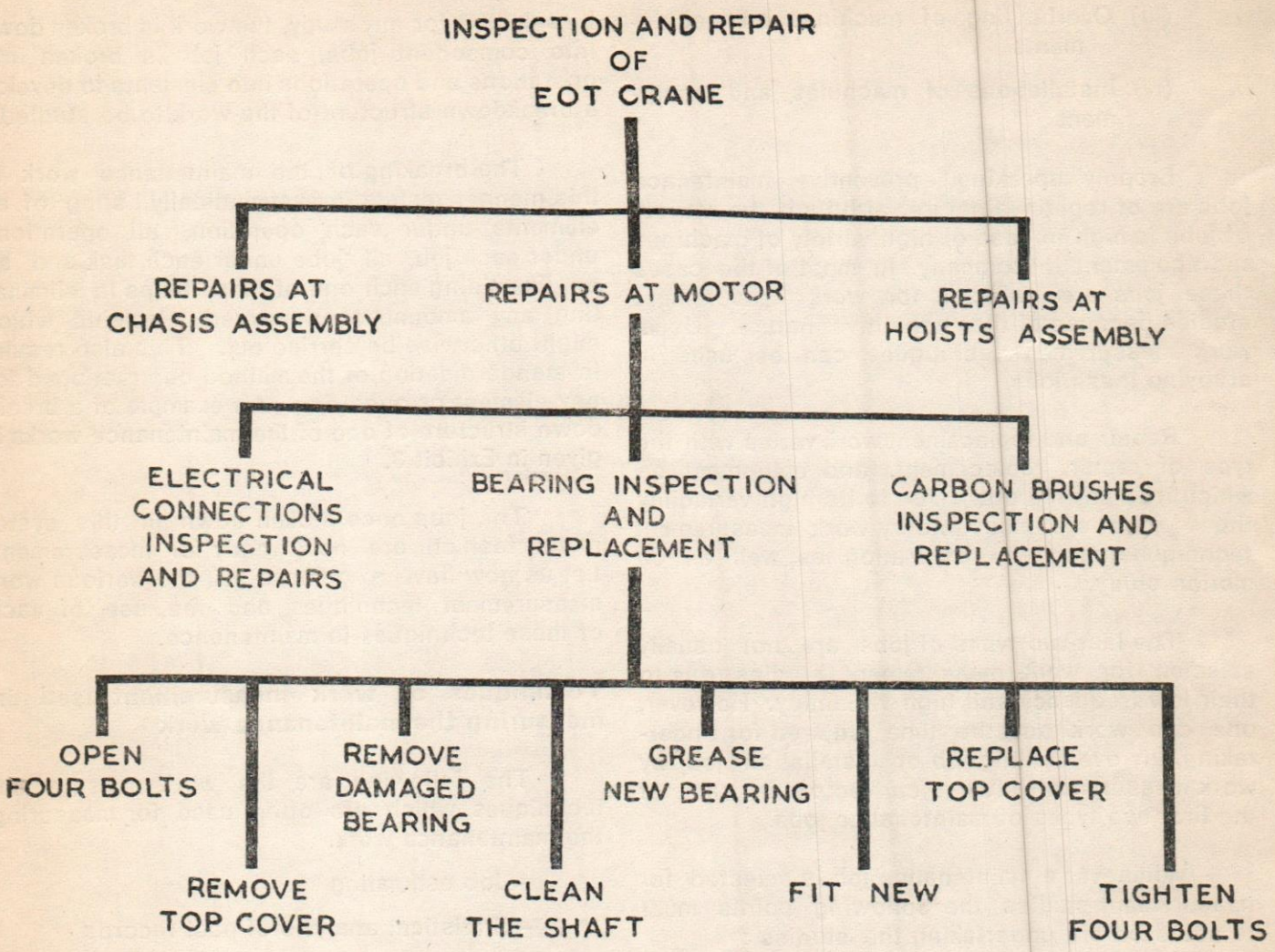

Exhibit 3 : Example of a Breakdown Sinetur

possessing personnel knowledge of the job in question is useful for a company that desires to plan its maintenance activities on a rough basis and has no data to apply other techniques of work measurement. A decision to use this technique should be made with the full realisation of its limitation. In case of use of this technique the person carrying out the job estimating should be competent and should have sufficient experience in the job.

Statistical Analysis of Past Records

This technique is based on the statistical principles and law of averages. The technique requires the existence of a work order system for the past period with data recorded about the time taken for various operations on different occasions in the past. The data for the past 6-12 months are taken and divided into the following categories :

(a) Routine Jobs : like inspection, lubrition etc.

(b) Repetitive Jobs: like replacing gaskets, replacing keys etc.,

(c) Miscellaneous Jobs : these are divided into time groups, e.g. : Jobs taking 0-10 hours, 10-20 hours, 20-35 hours etc.

The total number of Jobs attended in each case as well as the total time consumed is worked out. The average time per occasion thus becomes the standard time for the Job.

Table 1

Example : Routine Jobs

	Total No. of Jobs Attended	Total Time Hrs.	Allowed Time Hrs./day
Oil Motors	200	1400	13.3
Clean Machines	210	3250	15.5
Grease Fans	180	2400	7.3
	Repetitive Jobs		
	No. of units Attended	Total Hrs.	Allowed Time Hrs./ Occasion
Change pump packing	27	9	0.33

Time Study

In this case the job is broken down into its elements. Each of the element is measured with the help of a stop watch and simultaneously the rate at which the worker is carrying out the job is noted. These observations are repeated over a sufficiently long duration to incorporate all possible variations. The normal time is then determined by multiplying the recorded time by the observed rate of working and dividing by normal rate of working. To the normal time, the allowances are added to arrive at standard time.

Application of this technique to measurement of maintenance work is limited because of the nature of maintenance job being not very repetitive. The procedure therefore becomes obsolete in case of non-repetitive maintenance jobs and cumbersome in case of other jobs.

It can however be readily applied to some routine and repetitive jobs or elements and helps a lot in the analytical estimating and standard data development. For determining the allowances to be added to normal times, generally other work measurement techniques such as work sampling or production study are used.

An example of time study carried out for determining the time for similar elements in case of a maintenance job is given in Table 2.

Average time for all the elements is worked out and the frequency of each element is also noted. The normal time for the job is then calculated by multiplying the frequency of the element with its average value and than adding up all these values. In this case since the frequency is 1 for each of the element, the normal time is sum of all the values in the last column i.e. =0.242 Hrs. or 14.52 minutes.

Table 2

DATE : 10th Aug.	SUMMARY OF ELEMENTS DETERMINED BY TIME STUDY			OBSERVER : SRO		
Job :	Cleaning the bearing		Engg. Deptt.		Equpt A C — 3	
Element No.	Element Description	High Value Observed Hrs.	Low Value Observed Hrs.	Sum of Observation	Total No. of Observation	AV Value Hrs.
A	Remove and reinstall 1/2″—3″ bolts using hand spanner 9	0.021	0.009	0.434	29	0.015
G	Clean the bearing with solvent and wipe	0.084	0.067	0.712	10	0.071
D	Remove and reinstall the bearing	0.140	0.030	0 336	4	0.084
M	Apply grease to antifriction ball bearing 2″—3″	0.050	0.032	0 282	8	0.036
H	Clean medium size parts with solvent	0.055	0.034	0.432	12	0.039

Production Studies

Production Studies are used to measure the maintenance work in those cases where the job is of a long duration. In that case the job has to be studies continuously for a few shifts instead of timing a number of cycles. Such long studies which are carried out by using a stop watch are called production studies. The stripping down for cleaning and reassembly of a spinning frame is good case for application of production study techniques. In case of production study time for all the elements are recorded continuously irrespective of fact that they are not a part of the job. At the end of the study the data is analysed and elements which are a part of the job and elements which are not the part of job but constitute preliminary activities are separated out. An example of the elements arrived after analysing the data collected by carrying out production studies in stripping a Barnsted still pump is given in Table 3.

Table 3

Summary of Elements Determined by Production Study

Equipment : Barnsted Still Pump	Equip No. PU—9	Date 4th Aug.
Job : Pump Stripping	288 rPM 2 HP	Observed by
Deptt : Engg. (Mech.)	Simple Stage Centrifingal Pump	K.S.S

S. No.	Description of Element	Time in Min.	Manpower
1.	Remove the Pump from its Mounting for overhaul		
	(A) Take off the coupling gaurd (Inut)	0.70	IF
	(B) Open Union of Suction end	0.70	IF
	(C) Open Union of discharge (Hammer)	1.40	IF
	(D) Open coupling bolts & nuts	2.20	IF
	(E) Open Foundation bolts (4 NO)	2.80	IF
	(F) Remove the pump from Foundation	0.30	IF
2.	Open pump and cover (6 bolts)	3.50	IF
3.	Take off cover	0.50	IF
4.	Open Grease cup	0.15	IF
5.	Open locknut of pump coupling flange, open the bolt	1.25	IF
6.	Take off coupling flange	16.00	IF/IH
7.	Open Olock nut of impeller and take out impeller	4.20	IF/IH
8.	Take out shaft with bearings, open gland nuts	2.20	IF/IH
9.	Take off grease, inspect the shaft	1.20	IF/IH
10.	Hammer and take out bearing	0.85	IF/IH
	TOTAL =	37.95	

Ineffective Time	Min.
a) Material handling	= 5
b) Planning and instructions	= 5
c) Balancing delays	= 2
d) Personal	= 2
e) Others	= 4
(i) Total elapsed time	= 56 Mts
(ii) % ineffective time over elapsed time	32.1 %
(iii) % effective time to elapsed time	61.9%
(iv) Ratio of ineffective time to effective time	= 47.4%

This production study has been utilised to measure the effective and ineffective time in carrying out the job and the ratio of the effective to ineffective time. It is often found that much time is wasted in balancing the delays in group work. In such cases the production study data can helps us the re-grouping of manpower to balance the utilisation in group work.

Analytical Estimation

This is a technique which is very commonly used for measuring the maintenance work. Basically with the help of this technique "time required to carry out elements of a job at normal rating is estimated from the knowledge and experience of the elements concerned". Since in this case direct measurement is not required, it can very effectively be used for measuring non-repetitive work. The procedure for carrying out analytical estimation involves the following steps :

(i) Identification of skilled and experienced supervisor, who knows the job thoroughly, as the estimator;

(ii) Training the estimator in the techniques of work measurement and giving him a mental concept of normal performance of work;

(iii) Breaking the job into elements and clubbing similar elements together for comparison;

(iv) Wherever possible determining the times for elements from the synthetic

data developed based on time studies carried out earlier. Wherever data is not available, estimating the time for the elements at normal rate of working;

(v) Adding up elemental times for all the elements to get the total normal time for the job.

(vi) Adding allowances to the normal time to get the standard time for the job.

In this case the elements identified for the purpose of estimation are much larger in size than the elements in time study. Since the time for these elements is estimated, the accuracy of the estimated time is much less than in time study. The accuracy also depends on the training and experience of estimator and can result in chaotic results in case of an in-experienced estimator.

The performance of the estimator can be considerably improved by first carrying out time study for a few elements and then estimating similar elements. This helps in establishing the base for estimation and a number of such repetitions can identify the error in estimating as well as improvement in performance. In table 4 is given an example of the use of analytical estimation technique for estimating the time for 'Removal of Norva washing machine from the mounting and its disassembly for overhaul'.

The manpower used for various elements was also noted simultaneously.

Table 4

ANALYTICAL ESTIMATION SHEET

Ref. : CLNO 40HY Equipment : Norva Washing Machine Estimator : RMN

Deptt. Final Products (Engg.) Equipment No. : NW 1 to 4 Date : 9th Aug.

JOB DESCRIPTION : Remove the machine from the mounting and disassemble

S. No.	Description of Element	Manpower	Normal Time Mts.
1.	Disconnect Motor		
	(a) Open two bolts		2
	(b) Lift and keep aside	1F 1H	1
2.	Disconnect distilled waterpipe, Remove union	1F 1H	3
3.	Drain off Water	1F 1H	3
4.	Remove steam connection	1F 1H	3
5.	Open foundation bolts	1F 1H	4
6.	Lift the machine and take out	1F 3H	8
7.	Drain off oil from the gear box	1F	2
8.	Open the cover (three screws)	1F	3
9.	Open the locknut	1F 1H	2
10.	Remove worm with bearing (with the puller)	1F 1H	8
11.	Remove bearing at the other end of work	1F	4
12.	Open gland (at the other end)	1F	2
13.	Open the end cover (2 bolts)	1F 1H	2
14.	Pull the drum out (2.3 ft. Dia) (Distance 8 ft).	1F 1H	5
15.	Send the drum to workshop for key-way and other repairs	2H	12
16.	Remove the bearing at the other end	1F	4
17.	Remove the rotor	1F 1H	2

Total Normal Time for the Job = 70 Mts.

Work Sampling

This is a technique based on statistical principles to measure the work content in any job in any department. Basically it consists of taking sample observations at random intervals of time for the job to be studied and then calculating the proportion of the sample observations that recorded the state of the job. This value tends to represent the time spent by man or machine in that state of the job. Let us say a study of this nature consists of 100 days to check for what time the maintenance worker was working. If the number of observations when he was working are 600 it means he is spending 60% $\left(\frac{600}{1000} \times 100\right)$ of his time in working.

This technique can be very effectively used for the following :

(i) To measure the utilisation of maintenance worker.

(ii) To measure the time required for non-productive as well productive work in any maintenance jobs.

(iii) To make the assessment of manpower required for any maintenance job.

(iv) To balance delays in the jobs undertaken by group of people.

(v) To determine allowances required to be given in case of maintenance jobs.

In one of the work sampling studies carried out in the maintenance department, the objective was to determine how the time for a maintenance worker is spent on the various items of work. The items of work were grouped into seven classifications. The details of each class along with its code is given below :

Class of Activity	*Code*
Working	W
Planning (Instructions, preparations)	P
Transporting tools, materials or spares	T
Waiting for materials, tools or spares	W_t
Balancing delays in group work	B
Personal needs	N
Idle, no job.	I

The study was planned and a total number of 3500 observations were made to achieve an accuracy of 5% in the activity "Working". The observation of First Shift Study in the format used is given in Table 5. The study was carried out for 12 days in all the three shifts. The result of study are summarised in work sampling summary sheet as given in Table 5. The results of the study were used for providing time for planning the job, time for transportation, balancing delays, etc. while developing time standards for various jobs in the industry.

Table 5

Summary of Work Sampling Study			Observed by KMN, KSS, SKO
Deptt. Engg. (Mech)	Category : Trademen (Mech)		Period of Study : 5th Aug. to 16th August.
S. No.	Activity	No. of Observation	Estimated % of Time
1.	Working	1050	30
2.	Planning (Instructions) & Preparations for job)	105	3
3.	Tranporting tools, materials or spares	175	5
4.	Waiting for tools, materials or spares	140	4
5.	Balancing delay	210	6
6.	Personal needs	735	21
7.	Idle	1085	31
	TOTAL	3500	100%

Synthetic Data

The technique of synthetic data works on the principle of making the words if alphabets are known. Just as language contains a lot of alphabets and the word is built by joining a number of alphabets at the required positions, the synthetic data technique indicates that there is a limited number of elements in the maintenance jobs. If a data of normal times for all these elements is built up after carrying out a number of studies for various elements the data can be used for working out the time for any job by the steps given below :

(i) Break the job into the elements

(ii) Compare the elements of the job with the elements in the standard data table of similar elements

(iii) Note the normal time for each element from the standard data table

(iv) List down the frequency of each element

(v) Calculate the normal time for job by multiplying the elemental time value with its frequency and then adding up

(vi) Determine the allowances for the job based on the conditions of work

(vii) Add allowances to the normal time to get the standard time.

This technique is more useful for determining the maintenance work time when a lot of studies have already been carried out and data is built up by first classification of elements based on its type, and then building up the standard data tables for each class of elements and finally indexing them. The technique is expensive to start with and requires a lot of efforts but is quite useful in the long run to develop "Maintenance Time Standards".

PMTS/MTM : Pre-determined Motion Time Systems and Methods Time Measurement techniques are based on the fact that all jobs are made up of a set of basic body and limb motions and time for lowest level body or limb motion is constant. If the job can be broken into its basic motions then the time for all these basic motions can be added to get the total time for the job. Application of PMTS and MTM to Maintenance

Work has restricted scope in India because of the cost involved and due to the fact that this class of work can be visualised and standardised in the manner required with great difficulty and with lot of time consumption.

We have gone through the details of each of the work measurement technique and its scope and limitations in case of measuring the maintenance work. In most of the cases these techniques are used in determining one or more items mentioned below :

(i) In assessing utilisation of the maintenance worker

(ii) In determining the percentage of time required on various activities such as planning, transportation delays, etc.

(iii) In determining the maintenance time standards for different maintenance jobs

(iv) As a basis to develop incentive schemes for maintenance worker

(v) In improving the working methods for maintenance jobs and in its comparison

(vi) In assessing the manpower required for maintenance department

(vii) In determing the allowances for various jobs.

Application of Work Measurement Techniques to Develop Maintenance Time Standards

In order to plan the resources required in carrying out any maintenance work we require a yard-stick to measure all the resources. The most critical resource of manpower is measured in terms of time. We therefore require the amount of manpower needed in terms of time so accurately that it can be used for the purpose of planning and control. These times against which the performance of maintenance work force is measured are called "Maintenance Time Standards".

The development of Maintenance Time Standards has got the following limitations and constraints because of which there are very limited attempts to develop these standards.

(i) The variety of job in a maintenance department is too large, therefore it is often very costly to develop Maintenance Time Standards

(ii) Most of the maintenance jobs are non repetitive in nature so it is difficult to develop standards for maintenance jobs

(iii) The procedure to carry out maintenance jobs varies from worker to worker and from condition to condition. In the absence of a standardised method it is difficult to develop uniform standards for maintenance jobs

(iv) It takes too much time as well as manpower to fix up standards for maintenance jobs. So the advantages gained out of a maintenance standards programme are often outweighed by the high cost involved.

Due to the constraints and limitations mentioned above it is very difficult to set up exact standards for maintenance jobs. It is therefore advisable to set standards based on "Range of Time" concept. In order to determine the range, the concept of probability has to be used. The range can be determined with 95% confidence level or probability. In other words, if a job is completed in a range of time 95 times out of 100, then the job will be completed within the assigned time.

A few attempts made to develop Maintenance Time Standards resulted in what are called "Universal Maintenance Standards" (UMS), "Basic Work Data" (BWD) and "Engineering Performance Standards" (EPS). All these were based on the concept of developing Synthetic Data for the maintenance jobs and then building up the standards from them. These were developed based on the concept of Range of Time for a maintenance job rather than a Single Time. A general approach to develop MTS based on Synthetic Data approach is discussed here.

Development of Maintenance Time Standards-Synthetic Data Approach

This approach will be discussed briefly under the following three heads :

I Development of General Data

II Development of Craft Formula

III Development of Time Standards

Development of General Data

General data comprises time values that have to be added to direct work for obtaining the allowed time. This constitutes the following :

(a) Job preparation time

(b) Travel time

(c) Allowances

Job preparation time consists of time for :

— Obtaining instructions

— Considering instructions and planning for tools, materials spares and procedure to carry out the job

— Collecting tools, instrument materials and laying them out at the site

— Storing the tools and instruments at the end of the work

These are worked out for average working conditions and for different crafts separately. The work sampling technique are often used to get an idea of the time spent on various activities.

Travel time consists of :

— Time required for loading and unloading the tools into and out of the vehicle

— Time for round trip, from the shop to work site

The first part of travel time is constant and can be easily worked out for different crafts and averaged out. For the second part the entire work area is divided in different zones and travel time is developed from the shop to the zone. The different zones will have different group time ranges and average value of the group time range is used for the planning purpose.

A company divided to work area into 10 zones and worked out the travel zone time as in Table 6.

Allowances :

In most of the maintenance work the allowances are of following types :

—Relaxation allowances to compensate for fatigue and personal needs

—Balancing delays (in group work)

—Unavoidable delays and contingencies

—Planning time (inspective job site, discussions with supervisor, etc.)

Table 6

Travel Zone Time Ranges

Zone No.	Group Time Range in Hrs.	Zone Time Value in Hrs.
1.	0 — 0.20	0.15
2.	0.21 — 0.30	0.25
3.	0.31 — 0.40	0.35
4.	0.41 - 0.50	0.45
5.	0.51 — 0.60	0.55
6.	0.61 — 0.70	0.65
7.	0.71 — 0.80	0.75
8.	0.81 — 0.90	0.85
9.	0.91 — 1.00	0.95

For this a sample work sampling study is required and it can be determined craft wise. A pharmaceutical company worked out their allowances based on work sampling study as given in Table 7.

Table 7

Craft	Relaxation Allowance %	Unavoidable Delays %	Balancing Delays %	Planning %	Use of Allowance	
					Our Man Job %	Group Job %
Machine repair	15	10	10	10	35	45
Electric repair	10	8	8	12	30	38
Moving & Rigging	20	10	10	10	40	50
Painting	15	5	2	2	22	24
Masonary Work	10	10	10	5	25	35
Welding	17	10	5	5	32	37
M/c Shop	10	8	2	8	26	28
Plumbing	12	8	10	10	30	40

II Development of Craft Formula

A craft formula is a collection of standard data arranged in the form of an algebric equation to give the levelled time (including general data) for a task in a given craft. The procedure of developing craft formula for an operation is given in Exhibit 4.

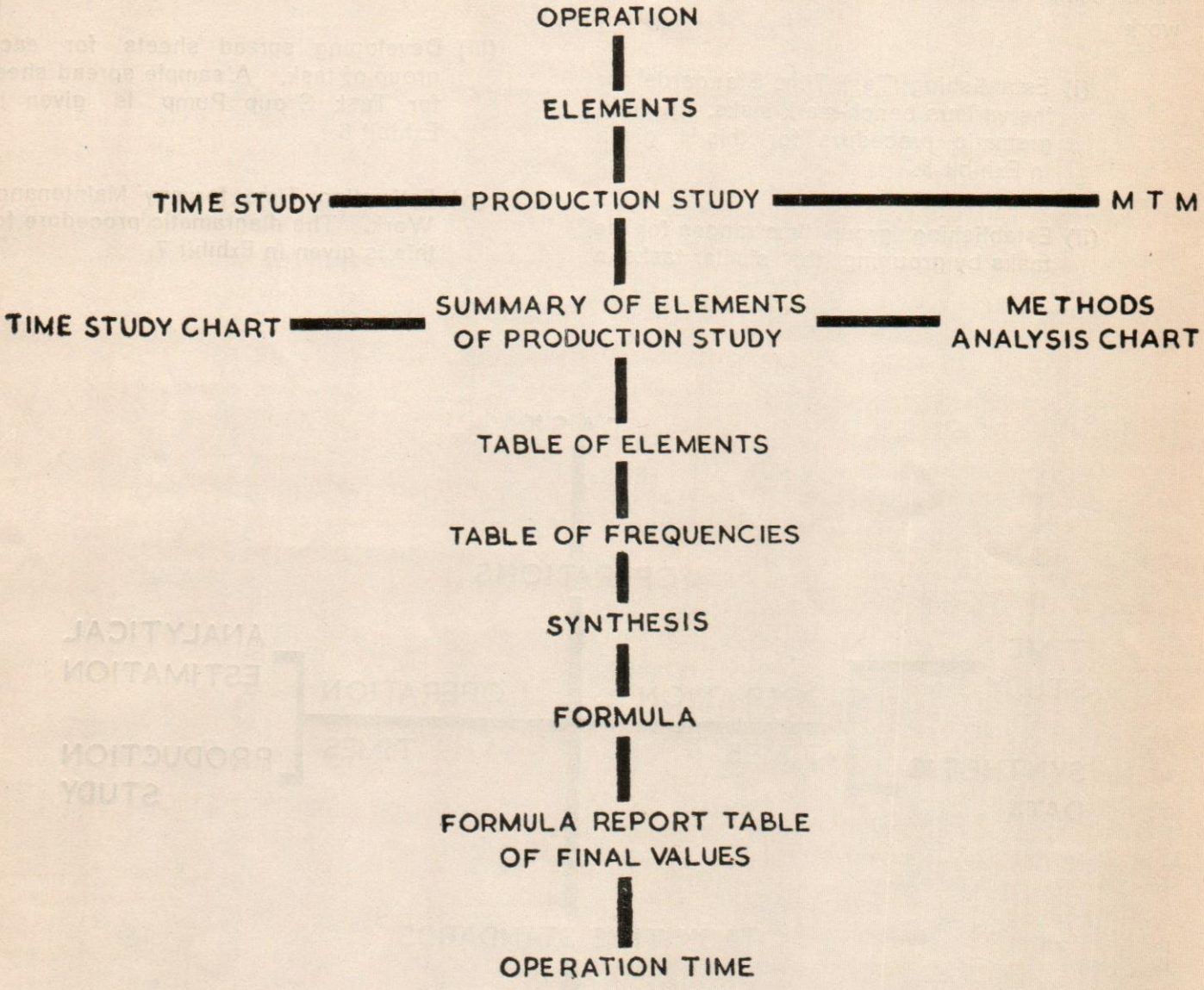

Exhibit 4 : Development of Craft Formula

The entire process consists of the following steps :

(i) Establishing bench-mark tasks in each craft

(ii) Identification of list of operations in each bench-mark Task

(iii) Preparing table of elements in each operation and developing synthetic data by conducting studies

(iv) Preparing a table of frequencies

(v) Synthesis of the entire formula

(vi) Determining the operation Time

Once the craft formula is ready one knows the equation to work the time for any job.

Development of Time Standards

Once the craft formula for various tasks are ready the following steps are carried out to determine Time Standards for any Maintenance work

(i) Establishing 'Task Time Standards' for the various bench-mark tasks. The diagramatic procedure for this is given in Exhibit 5.

(ii) Establishing group time ranges for the tasks by grouping the similar tasks in the same craft together and then providing the man value for the group. For any task to be undertaken the maintenance planning is done on this group time value.

(iii) Developing spread sheets for each group of task. A sample spread sheet for Task Group Pump is given in Exhibit 6.

(iv) Estimating Time for any Maintenance Work. The diagramatic procedure for this is given in Exhibit 7.

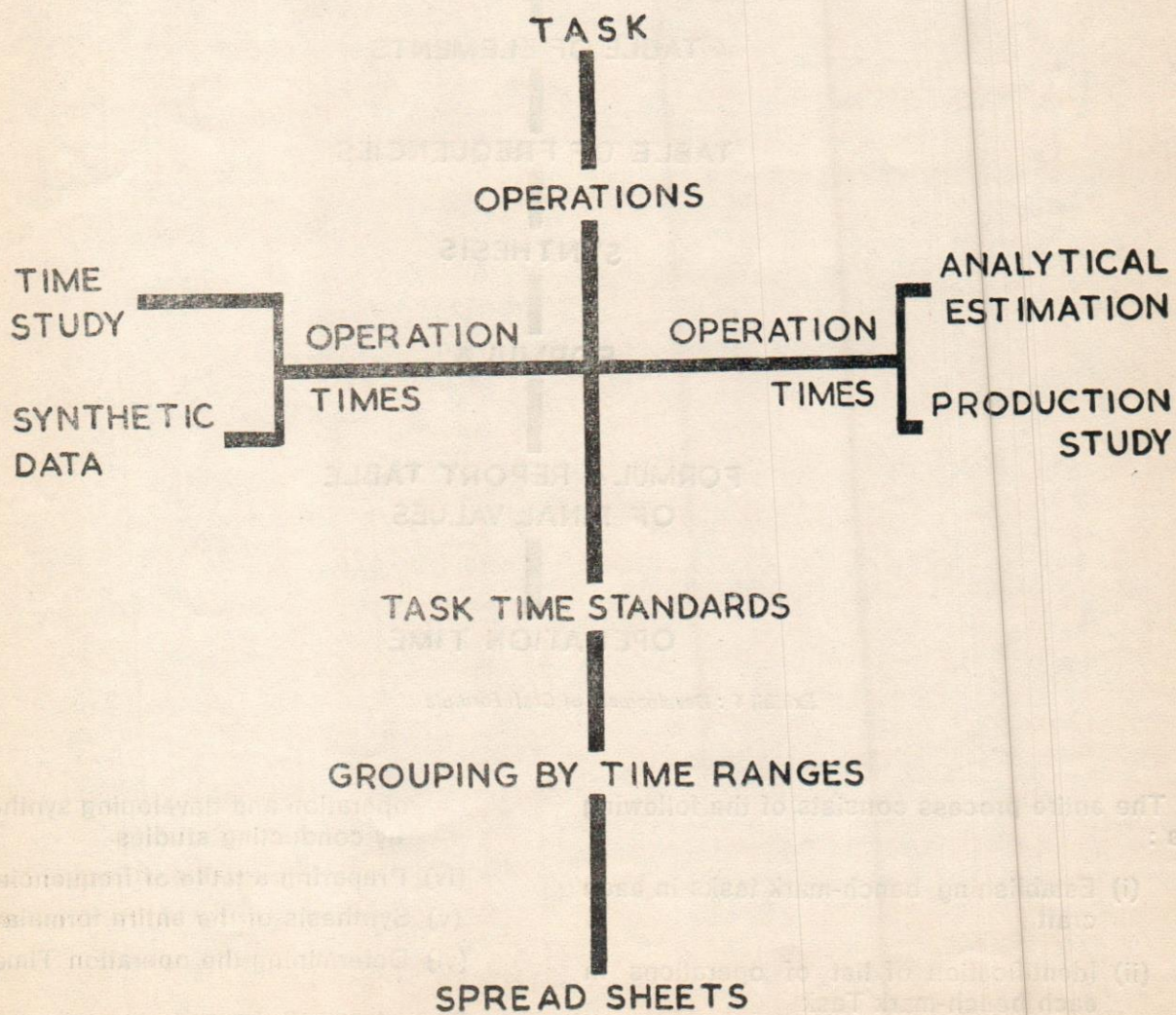

Exhibit 5: Development of Task Time Standards and Spread Sheets

Task Area : Pumps-Remove, Disassemble, Clean, Inspect, Reassemble, Reinstal

Group A/Allow 0.75 Hrs.	Group B/Allow 1.50 Hrs.	Group C/Allow 2.75 Hrs.	Group D/Allow 4 5 Hrs.
		Clean, Lubricate, Align and Inspect a single-stage, centrifugal (Worthington) pump with flexibile coupling (Impeller and bearings. Does not include removal/installation (e.g. APV still pump F & P) Manpower MT-17	Disassemble, Inspect and Reassemble as ingle-stage centrifugal pump with flexible coupling. Includes alignment and valve servicing. Manpower : IF, IH MT-21
Clean, Lubricate, Adjust and Inspect a single-stage monoblock centrifugal pump includes Impeller and bearings (DW PUMP) MT-10	Clean, Lubricate and Inspect a single stage centrifugal pump with flexible coupling includes Impeller and bearings. Does not include alignment. MT-14		Remove, Disassemble, Clean and Reassemble a single-stage, centrifugal (Worthington) pump with flexible coupling. Includes alignment suction and discharge flanges. Manpower : IF, IH (Part-time) MT-22
Remove, disassemble, Clean, inspect and Reassemble a single stagse, centrifugal pump (Impeller 2"—4") (e.g., Alfa Level Recirculation Pump-CLP, Manpower IF MT-11	Remove, Disassemble, Clean. Inspect and Re-assemble a single-stage monoblock centrifugal pump. Includes put into operation (e.g., DW PUMP) Manpower : IF, IH MT-16	Remove, Disassemble, Clean Inspect and Reassemble a single-stage centrifugal pump with flexible coupling. Does not include alignment. Manpower : IF, IH (Part-Time) MT-20	

Exhibit 6 : Sample spread for Task Group Pump

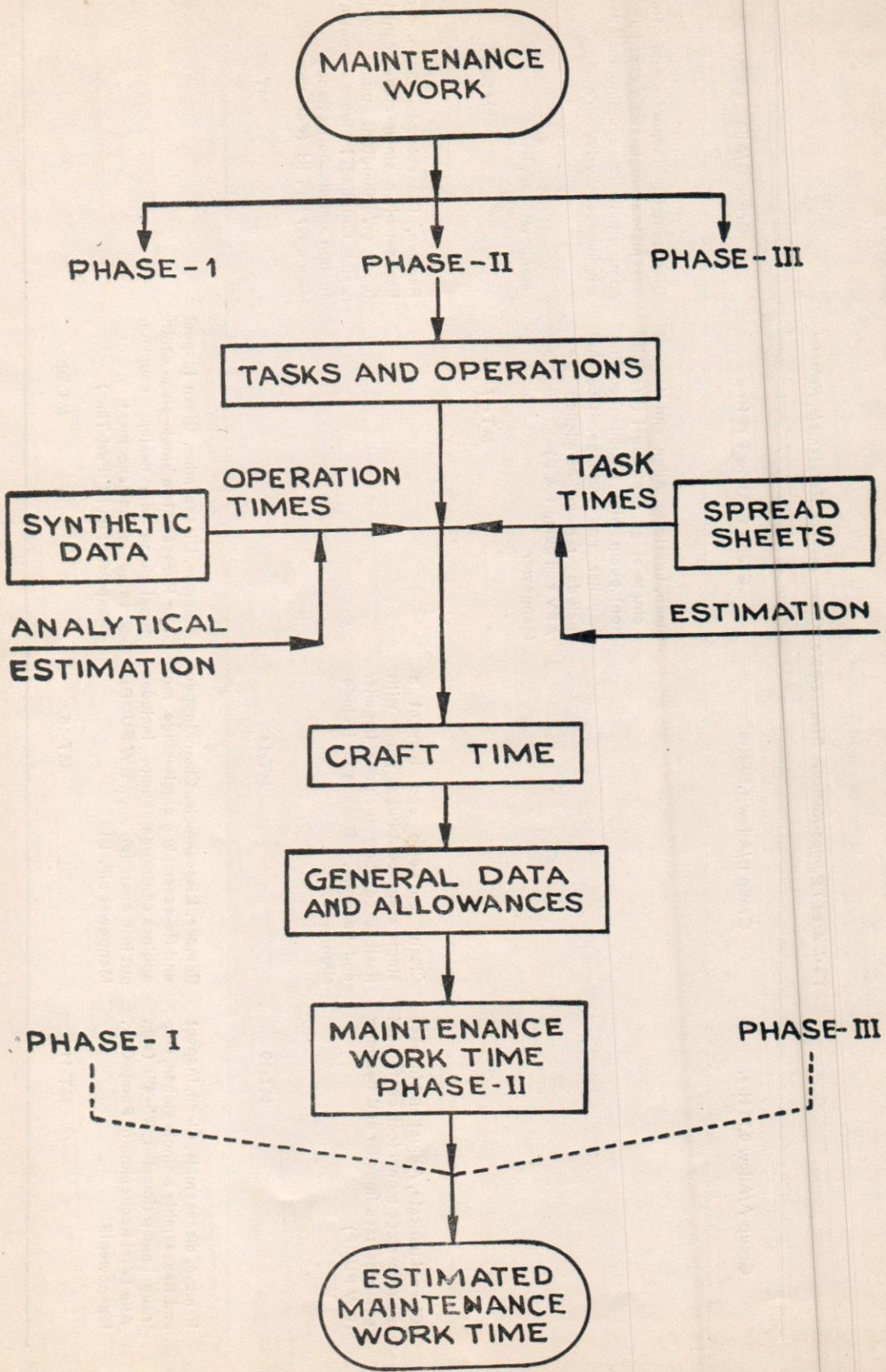

Exhibit 7 : Estimating Work Time With Maintenance Time Standards

Productivity
1982, XXIII, 1, 85-89

EXECUTIVE READINGS

Managing Large Organisations

Ishwar Dayal and Others
All India Management Association, 1981, New Delhi.

Reviewed by Dr. J. P. Singh, NPC New Delhi.

Looking at the title and the name of the first author one is tempted to purchase the book for library use. However, reading the book is a disappointing experience. The title suggests that it is aimed at understanding the processes and problems of managing large organisations. The sub-title further leads one to assume that the book aims at a comparison between large and small organisations. It, however, turns out that the book is a mere reporting of a study of five 'large' organisations in Nigeria.

In authors' own words the study aims at :

(a) "The need to understand the background of employees in organisations, their motivation towards seeking employment and their attitudes and values".

(b) "...an urgent need to learn how (management) problems are to be dealt with and whether size has any bearing on managing practices and whether different kinds of technology generate different styles of management" and;

(c) "...the need to know whether culture and tradition have an impact strong enough to influence management practices in organisations".

The study of five organisations in Nigeria includes two educational institutions, and two foreign organisations. The book is organised in three sections : part I gives the profile of the employee; part II gives the profile of management and five case studies of organisations and part III gives the implications for management. It is obvious that while the study is helpful in understanding some of the dynamics operating in an organisation, it does not justify the title of the book.

While the real contribution of the study should be in the part III, on 'implications for management', even in here one really has to hunt for the conclusions. Most of the material is repetition of what has been said earlier in the book. There is hardly anything new the study offers which is a contribution to our learning of the management processes in a large organisation in a developing country. There is a chapter titled "Some Directions for Managing Large Organisations". However, it only gives the analysis and characteristics of the organisation based upon the foregoing cases without specifying implications. Perhaps the only relevant material is given on pages 195 to 198.

By and large the book does not contribute anything significant to the management literature. It also fails to specify the target group for whom it has been written. The index at the end is too brief to be of any use to the reader.

Management of Human Resources—A Behavioural Approach to Personnel

Dr. R. S. Dwivedi, Reader, Kurukshetra University, Kurukshetra.

New Delhi : Oxford & IBH Publishing Co., 1982, 499 pp.
Price : Rs. 60.

Reviewed by Gopal Narain, Deputy Director (Administration) National Productivity Council, Lodi Road, New Delhi.

In the sixties and seventies adherents of the "human relations" school were often critical of the approach of what is called the "classical school" or scientific management" propounded by Taylor. It was erroneously believed that there was a dichotomy between scientific thinking and concern with people in the organisational set-up.

The behavioural scientists have been trying to change this concept and present an approach which involves interdisciplinary, scientific study of human behaviour in an organisational set-up. The present book is based on this approach and integrates the theories of various behavioural disciplines by adopting a systems view point.

The book is divided into nine chapters dealing with such subjects as Manpower Planning; Selection; Training and Development; Performance Appraisal; Compensation Systems, Morale and Productivity and Labour Relations. Each chapter is followed by a summary and model questions and a list of suggested reading. Throughout the text examples from the Indian experience have been drawn upon and this makes the book of use to the practising managers. On the other hand, the serious student will also find much valuable material to spur him in further thinking.

The last chapter contains thirteen case problems dealing with various facets of human resource management in Indian industries. Each case is followed by a short paragraph giving "Study Guides".

While many would welcome the inclusion of questions at the end of each chapter and each case in the last chapter, this reviewer finds them abhorring. They may seem to make the task of the reader easier but in reality contribute little to the development of a creative mind the test of which is to be able to ask relevant questions (and find answers) rather than to try to answer ready-made questions. Our whole educational system is designed around the need for accumulation of knowledge and not with developing curiosity and it would be worthwhile for authors to try to discourage this trend through their works.

There was a time when few Indian books had an index. I am glad the present book does not suffer from this deficiency.

Students of personnel management and industrial relations as well as middle-level executives dealing with actual human problems will find this book worthwhile.

Production Planning and Control

L. C. Jhamb
Aditya Publishing House, Pune, 1981, pp. 352, Rs. 35/-

Reviewed by K. Kittappa Director, National Productivity Council, Bombay.

Production Planning and Control function of an organisation is an 'informiser' function which is responsible for the processing of information and communicating optimal decisions to the 'realiser' functions and also for the control of achievements against the planned results. The author in this book has explained the functions of PPC, tools & procedures useful for information processing and the proper work involved.

'Our Customer is Our King.....A firm which aims at customer's satisfaction is never short of business'—It is with this conviction the book is started and proceeds to explain the mechanics of satisfying 'our king'. This book as told in the preface, is the outcome of the author's consultancy experience and the present job assignment. One also feels so while going through the pages — the approach is pragmatic and presents all key activities of PPC.

The objectives and functions of the department are explained in the initial chapters (1, 2). The functions starting from receipt of sales enquiries to the task of follow up are presented in 15 stages with brief description. This

helps in understanding the total work of PPC at a glance. The comparative table on 'common functions and optional functions of PPC' explains the difference in scope as existing in PPC departments of different industries. However, the chapters on Planning Vs Control and Organisation (3,23) are theoretical and lack clasity and depth.

The chart explaining the relationship of PPC with other departments (4) is explicit. A detailed study of these interactions will help in designing the information flow system.

The author has presented a checklist for the effectiveness of the PPC as evaluated by the other departments. It gives the characteristics which other departments expect of PPC and the fulfillment of which ensure better relations and results. It is a good attempt to bring the subjective element of evaluation into quantitative terms.

In three chapters (6, 7, 8) the factors influencing the design of PPC system and the prerequisites are presented which include the type of production and their characteristics, degree of centralisation etc. and the various input data to be prepared at pre-planning stage. It would have been more useful if the author had spent a few pages on the suitable structure and PPC system for different types of production. The formats suggested for the input data are explicit and can be followed by the user without much modifications.

Material Control is another aspect which has been dealt in detail (10 to 13). Especially the make or buy decisions and raw material estimation have been explained with practical sample calculation and data formats. But one thing which is conspicuous by its absence is the control of 'work in process' inventory. The author could have oriented the scientific stock control chapter rather on the control of inprocess inventory than on the raw material control which is mainly a purchase/ inventory function. One may argue that mathematically the treatment is same in both cases nevertheless the terminologies and considerations like bottle-necks, buffer, flow rates batch quantities, tool life etc. are typical of inprocess items.

The discussion and the exhibits in the process planning and tool control section (14 to 17) are practical and avoid conceptual frame work. This speaks for the author's involvement in the 'bolts and nuts' of PPC and would help the readers in understanding the reality of planning problems and designing their own system.

The scheduling methods (18) and the use of Gantt Chart are explained with all the computations required supported by numerical examples. Considering the fact that this is one area not clearly understood and effectively practised in medium and small industries, I feel more emphasis could have been laid on scheduling. More explanation and examples on machine loading, priority and optimisation would help the reader than the cursory description of the project scheduling (19—CPA) specially when most of the formats in the book are for non non - project oriented production. And there are ample number of publications on network and its use in project type activities.

The paper work suggested for despatching and progress chasing (20,21) are generalised and can be used by the reader with minor modifications to suit his requirement.

Barring a few minor defects like arithmatical errors, repeated usage of words like 'in lieu of' (sometimes at in-appropriate places), this book gives a down-to-earth approach to the design of PPC system and advocates better co-ordination for planning and improving capacity utilisation of resources.

Industrial Potential Survey : Its Nature and Problems in Developing Economics"

S. N. Bhattacharya
Metropolitan, New Delhi 1981.
Rs. 75. pp. xv + 221

Reviewed by Vimala Raghavachari, Delhi University

India has often been described as a rich country—potentially. What is true of India, is true of every underdeveloped country and what is required for rapid development is a translation of this potential into rising per capita income. A sound investment policy will help in converting the industrial potential into economic reality. Maurice Dobb mentions, that in an underdeveloped economy, the formulation of a sound investment policy involves, at

least three related policy decisions (1) the determination of the total amount of investment to be undertaken (2) the distribution of this total among different industries (3) the determination of the appropriate level of particular investments

The book by Prof. Bhattacharya broadly deals with the second aspect mentioned above and the industries appropriate location. Selection of industries and their location depends not merely on the national priorities but also on the possibility and feasibility of developing a particular industry in a particular region. Prof. Bhattacharya addresses himself to this problem of identifying the industrial potential of the different regions of underdeveloped countries. In his own words, "a comprehensive knowledge of the existing industries and detailing ways and means to develop these industries on the one hand and to intimate measures for the establishment of new industrial enterprises on the other, are the two major objectives of conducting Industrial Potential Surveys" (preface).

With this object in view, the author offers a 'guide' as to the *modus operandi* of such surveys. In view of the author's experience as a faculty member at 'Small Industry Extention as Training Institute', Hyderabad, there is a special emphasis on small and village industries. There is no doubt that rural industrialization / development is an integral part of industrialization of the economy as a whole and there is every need to identify the industrial potential of every region and help develop the indicated industries therein.[2]

In order to do this i. e. assess the potential and prepare an action-oriented plan the author envisages the need to acquire various types of information and co-ordinate them. The necessary prerequisites are :

1. the collection of background information of the district/area selected and its over all economic, political and social set up.

2. The availability and adequacy of the infrastructure needed for the development of industry viz. power, transport, communications, finance etc.

3. identification of resources viz. agricultural, mineral and other natural as well as human resources and its end uses in the studying of existing industries and their problems.

In the light of above information and its analysis 'candidate' industries can be suggested after a careful evaluation of the availability of resources, infrastructure for the product and a study of the products' present and prospective demand. In this connection the author refers to the growth-pole idea and the growth-centre strategy that is used in India as a tool for planning agricultural and industrial development. (pp. 121-126). Growth centres policy helps in planning urbanization of the country so that mass exodus to the metropolitan areas can be prevented by a planned creation of gainful non - farm avenues of employment in medium sized cities and smaller sized towns. Selected growth points, growth centres and growth poles, the three hierarchic levels of development, promote economic and social transformation of the area in an optimal manner identifying and utilising the available resources, including entrepreneurial resources. Some case studies are cited to illustrate.

The methodology for all this revolves around mainly two tools of analysis. The questionnaire takes care of the background information, infrastructure and resources identification, while evaluation of 'candidate' industries makes use of techniques of demand projection as well as questionnaires. There are numerous suggested proformas of the questionnaires (called lists or tables in the book) covering all aspects discussed in the book.

One wishes that all these questionnaires had suitable titles and listed in the table of contents. This would have been a great help to the reader and one suspects to the author too. Duplication could have been avoided. Similar or same questions are repeated some times in the different lists. For

1. M. Dobb "On Economic Theory and Socialism" London 1955.
2. That rural development/industrialization with high employment content is possible with large scale industrial unit has been brought out in a paper "The Sugar Factory and Rural Industrialization" by the reviewer in this very issue of *"Productivity"*.

example the 'List of Information on p. 38 contains a number of questions on population indicators (question 1 to 9). Again in the same list question number 27 entitled 'economic indicators' asks similar questions and questions which are not very clear. "Urbanisation (%)" and 'growth of population in semi - urban areas (%)" need proper precise definitions before investigators can use the questions meaningfully. Many other questions are framed in such a way that they either can not be understood or can not be answered or will not be answered or the answer is not known. Some exampels are "time consciousness", 'risk taking aptitude and capability', response towards different activities in the plans of the study', 'awareness towards expectations', 'nature of will and power to save the people' (pp 42-43). How are these to be quantified and measured ? Again on p. 56 some questions are specially emphasized regarding the loan policy of public financial institutions. Research workers are aware of the difficulty and futility of eliciting answers/information to such questions. For example "Number of applications rejected and why", Any complaint regarding loans by those who apply and those who may be eligible for applying", etc. are not questions which will elicit full response, even for authority backed investigating team. For some questions there are no answers. Too many descriptive questions eliciting descriptive answers, introduces subjective bias giving rise to numerous problems in editing and coordinating the mass of information thus collected and *derive* meaningful conclusions. This reviewer would also like to suggest that units of measurement in any one study should be the same for convenience. For instance table 4.1 on land utilisation (p. 63) requires land area to be reported in acres while table 4.2 on the cropping pattern (p. 65) requires the area to be reported in hectares. While conversion of one into the other is not difficult, it is easier if the information is collected in the same unit.

While studying the existing industries to draw up priorities (p. 81) and while considering the rating of each 'candidate' industry (p. 93) it may be more worthwhile to estimate the cost-benefit ratio from the points of view of both the industry concerned and society. As the author himself points out, financial analysis for ascertaining the worthwhileness of an industry is full of gaps (p. 89). Apart from being interim reports, financial statements involve personal judgement in the treatment of various financial categories. Also those intangible factors like commitments, loyalty and integrity of management and employees etc. which make for successful or unsuccessful working of the unit can not be brought out in financial analysis.

Another integral part in identifying candidate industries is the forecast of demand. The techniques suggested for projecting demand (p 103) can not be commented upon as there is hardly any exposition of actual methodology involved in such projections.

The author suggests a number of ways of indentifying entrepreneurial qualities and promoting individuals with such qualities by providing other essential facilities. He rightly observes that while large industries can be set up with expatriate capital and entrepreneurship, small industries need to have a domestic entrepreneurial base.

Although the book can not be taken as a practical manual for surveying the industrial potential in a developing economy, Dr. Bhattacharya has highlighted the nature of the problems involved admirably. As he himself has cautioned (p. 120), no suggestions should be made in a hurry without adequate indepth studies of all relevant issues. There is a lot of information both in the text and in the appendices which, when carefully sifted provides valuable help to all those interested in rural industrial development.

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A Select Bibliography

S. N. VIG
National Productivity Council, New Delhi

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From the Editor-in-Chief

Public distribution system has an important role to play in developing countries having a democratic set up which seeks to serve the people. Its importance is well recognised in our country. In essence it constitutes the nervous system of the community and this problem has been agitating the minds of management experts, politicians, government officials as well as the common public. In fact, we have moved from farms to warehouses and then to the state distribution agencies who take the grains to the fair price shops. It is a long journey involving a gigantic transportation system to accomplish the expected tasks. It also involves procurement of foodgrains and other items of necessity through various channels, adhering to strict quality standards at every stage. Eventually, the common man's needs are to be met with an uninterrupted supply of the necessities of life.

If the public distribution system does not operate effectively, smooth working of the entire community is affected followed by countless manhours lost in waiting for the necessities of life. Maximum priority, therefore, needs to be given to such organisations as co-operative stores and supermarkets because they can play an important role in reaching the commodities to the end-consumer at the right place, at the right time and in the right quantity at predetermined prices. In the case of other channels where private ownership is involved, it becomes difficult to ensure a fair distribution programme.

Warehousing in the whole system of public distribution acquires importance because it acts as a cushion between fluctuating demand and supply. Demand can fluctuate on account of seasonal factors, and supply on account of breakdown of machines, stoppages and interruptions in the supply of raw materials and power. It is only through the warehouses that the effect of fluctuations in demand and supply can be neutralised. It is, therefore, essential that a good public distribution system is backed up by a network of warehouses situated at appropriate places.

Transport is another important element in any effective distribution system. It is essential to have an effective transport system for keeping the prices under control by moving goods from surplus areas to areas of shortages.

On the basis of a critical, analytical and diagnostic assesment of the working of the existing public distribution system in its totality, it can be said that there is an urgent need

on the part of central/state/public agencies for applying management concepts and introducing productivity techniques to ensure that the system does not get derailed. It can be made possible in several ways, viz., by developing the right type of channels handled by trained personnel committed to the co-operative movement, streamlining the transportation system on an Operation Research model so as to reduce movement to the minimum, ensuring rigid quality standards as required under the Prevention of Food Adulteration Act 1954, and adopting scientific and appropriate warehousing to minimise wastage, pilferage and spoilage. These measures have to be adopted on a continuing basis involving all concerned from top to bottom, with active involvement and support of the people, to enhance productivity and welfare of the community at large.